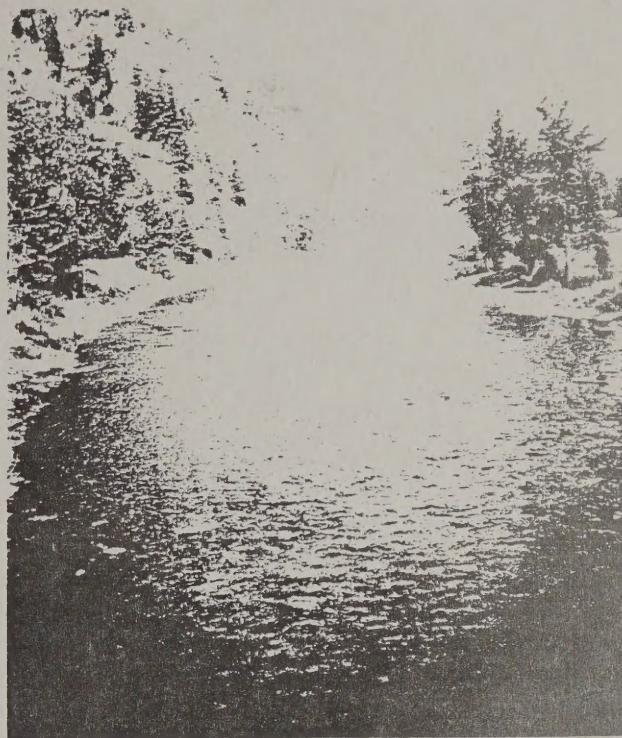




BLACKFOOT RIVER RESTORATION PROJECT PROGRESS REPORT

JUNE, 1997

MONTANA FISH, WILDLIFE AND PARKS



ABSTRACT

Abundant stocks of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) which comprise the majority of the fishery in the Blackfoot River, along with very low numbers of native bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), prompted assessment of fish populations and their habitats in 1993 and 1994. These assessments identified significant degradation in 17 of 19 primary tributaries. From 1993 to 1996, similar assessments have been completed for all additional tributaries to the Blackfoot River. Impaired fisheries existed in 28 of these streams, mainly from degradation of habitat on private lands.

An interagency effort restoring fisheries and riparian zones in the Blackfoot River drainage began in 1993. Cooperators include private landowners, non-profit groups and government and state agencies. Montana Department of Fish, Wildlife and Parks re-prioritized the time of two fisheries biologists to develop the Blackfoot River

Blackfoot River Restoration Project Progress Report

Restoration efforts have focused on riparian areas, including water leveling, streambank regrading, removing woody debris to create pools, installing spawning systems, removing barriers to fish migration and plantings riparian vegetation. Involvement of other agencies, particularly the US Fish and Wildlife Service Partners for Wildlife Program and private landowners, resulted in completed restoration projects on 23 streams, encompassing over 200 stream miles. Much of the restoration effort has occurred in tributaries to the middle reaches of the Blackfoot River. Resulting of these projects increased spawning opportunities and abundance of juvenile trout. The abundance of native westslope cutthroat trout and bull trout are increasing in less restored streams. Monitoring of these populations will show increased numbers of adult trout in the middle reach of the Blackfoot River.

Principle Investigators

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June, 1997

Brücke der Natur
Biosphärenpark
Rodenbach

ausgewählte Elemente

von 1992
bis 1996
mit
Bildern

1996

ABSTRACT

Declining stocks of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), which comprise the majority of the fishery in the Blackfoot River, along with very low numbers of fluvial bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*O. clarki lewisi*), prompted assessment of fish populations and their habitats in 1988 and 1989. These assessments identified significant degradation in 17 of 19 principle tributaries. From 1990 to 1996, similar assessments have been completed for 33 additional tributaries to the Blackfoot River. Impaired fisheries existed in 26 of these streams, mainly from degradation of habitat on private lands.

A cooperative effort restoring fisheries and riparian zones in the Blackfoot River drainage began in 1990. Cooperators include private landowners, non-profit groups and federal and state agencies. Montana Department of Fish, Wildlife and Parks re-prioritized the time of two fisheries biologists to develop restoration projects. Trout Unlimited supported this effort by raising funds, administering projects, contacting landowners and resolving conflicts. Restoration tools included water leasing, riparian fencing, changing livestock management, developing sites for off-stream watering, reconstructing stream channels, adding woody debris to streams, modifying irrigation systems, removing barriers to fish migration and planting riparian vegetation. Recruitment of other agencies, particularly the US Fish and Wildlife Service Partners for Wildlife Program and private cooperators, resulted in completed restoration projects on 23 streams, influencing over 200 stream miles. Most of the restoration effort has occurred in tributaries to the middle reaches of the Blackfoot River. Monitoring of these projects indicates increased spawning opportunities and densities of juvenile trout. The abundances of native westslope cutthroat trout and bull trout are increasing in some restored streams. Monitoring of river populations also show increased numbers of adult trout in the middle reach of the Blackfoot River.

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INTRODUCTION

Status of the fishery

A two year inventory of fisheries in the Blackfoot River and its principle tributaries was completed in 1989 (Peters and Spoon 1989, Peters 1990). These efforts focused on sampling populations of juvenile trout in tributaries, surveys of mainstem trout populations, and establishing fishery monitoring sites in 19 tributaries. Populations of trout in all reaches sampled in the Blackfoot River were below expected levels; numbers of native bull trout (*Salvelinus confluentus*) were especially low. Furthermore, the number of catch able-sized and juvenile westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the Blackfoot River were below levels that would be considered adequate to justify any angler harvest. The severe winter icing conditions that occur annually in the middle and lower reaches of the Blackfoot River is suspected to have caused high mortality of young-of-the-year (YOY) rainbow trout (*O. Mykiss*). The adaptive behavior of native fish to this severe, but natural environmental condition appears to hold the greatest promise to improve the fishery resources in the middle reaches of Blackfoot River.

Toxic mining wastes moving downstream from the headwaters and degraded habitat in the tributaries were the leading causes that reduced the viability of the fishery in the Blackfoot River drainage. Most habitat degradation occurred on private lands, and was associated with agricultural practices that were not sensitive to healthy range or streamside zones (riparian areas). Lower segments of most tributaries in the drainage contained populations of brown trout (*Salmo trutta*). Downriver of Nevada Creek, the lower segments of most tributaries also supported populations of rainbow trout, particularly younger age classes. From 1990 to 1996, fishery inventories have been completed on an additional 33 tributaries to the Blackfoot River, five of which are located in the Clearwater drainage. Of the 52 streams sampled since 1989, bull trout were present in 13 and westslope cutthroat trout present in 46. No new populations of bull trout have been identified since 1989. The legal harvest of bull trout and cutthroat trout was eliminated with the adoption of catch-and-release regulations in March of 1990. Regulations for rainbow trout and brown trout also changed, shifting from the taking of five fish to three fish under 12 in. These regulations were designed to increase survival of spawning size fish, thereby enhancing reproduction and recruitment.

From 1990 to 1996, restoration of stream habitat and water quality, wetlands and rangelands in the Blackfoot River drainage has occurred. Most effort has focused on improving riparian management along tributaries to the middle reaches of the Blackfoot River. Fishery restoration projects have been completed, or are progressing, in 23 streams as of 1997. These projects have included removing barriers to fish migration, restoring and enhancing trout habitat, protecting critical spawning habitat, enhancing riparian vegetation, wetlands and instream flows; developing low impact riparian grazing strategies, removing streamside feedlots and developing areas for off-stream livestock watering.

Agency Cooperators in these restoration efforts include Montana Fish, Wildlife and Parks (**FWP**), Fish and Wildlife Service (Partners for Wildlife Program) (**FWS**), Bureau of Land Management (**BLM**), Forest Service (**FS**), Environmental Protection Agency (**EPA**), Montana Department of Environmental Quality (Water Quality Division) (**DEQ**), Department of Natural Resource Conservation (**DNRC**), Montana Department of Transportation (**DOT**), and the North Powell Conservation District. Conservation groups cooperating with the efforts are the Big Blackfoot Chapter of Trout Unlimited (**BBCTU**), National Fish and Wildlife Foundation (**NFWF**), Ducks Unlimited (**DU**), Sundance Foundation and Orvis Company. Throughout this report these entities will be referred to by their acronyms. Private entities include Plum Creek Timber Company (**PC**), Montana Power Company (**MPC**) and the many families from the ranching

communities in the Nevada and Ovando valleys (Appendix, Exhibit D, E).

The objectives of this report are to summarize 1) native fish status and native fish recovery efforts; 2) habitat monitoring and fish population surveys in 47 tributaries to the Blackfoot River; 3) restoration techniques used on 23 tributaries and fish population monitoring results for those streams; and 4) potential fishery restoration projects for the future.

STUDY AREA

Blackfoot River

The Blackfoot River, located in west-central Montana, flows 132 miles in a westerly direction from its source near the Continental Divide to its confluence with the Clark Fork River at Bonner, Montana (Figure 1). The Blackfoot drains 2,400 square miles of watershed through a 3,700 mile stream network of which 1,900 miles are perennial streams capable of supporting fisheries. Land ownership in the Blackfoot Valley is 44% National Forest, 5% Bureau of Land Management, 7% State of Montana, 20% Plum Creek Timber Company and 24% other private ownership (Figure 1a).

In 1995, the Blackfoot River accommodated 36,220 anglers during the fishing season a 6 % increase from 1993 (Montana Statewide Angling Pressure 1995, 1993). It is a very popular fishing stream in western Montana and currently receives the third highest fishing pressure among streams in the Clark Fork River drainage upstream from the Flathead River.

The current economic value of the Blackfoot River fishery resource to the state of Montana, based upon travel cost methodologies is around 7 million dollars annually. Significant recovery of fishery resources resulting from efforts of private citizens and resource agencies since 1990 are adding to the streams overall health and its popularity among anglers. The economic value of Blackfoot River from non-fishing recreation such as campers, floaters, tubers, irrigators, bird-watchers, hunters and others, would probably greatly exceed fishing values based upon higher overall usage by these groups (Baxter and Sproull 1992).

Cutthroat trout are the most abundant trout in the upper reach of the Blackfoot River, with low numbers of bull trout present in the area of the Landers Fork confluence. Several small placer and hard rock mines exist here, of which the Mike Horse Mine is the largest. In 1975, the tailings impoundment for the Mike Horse Mine washed out, sending contaminated, toxic metals bearing tailings into the upper river. The Blackfoot River avoided large-scale ecological disaster only because it enters a series of large willow wetlands that contained and slowed the downstream movement of these sediments. Nevertheless, studies show high levels of sulfate and heavy metals coincide with poor water quality, low species richness and declining populations of cutthroat trout and brook trout as far as 9 miles downriver (Spence 1975, Moore et al. 1989, McQuire 1988). Ingman (1990) reported cadmium, copper and zinc concentrations exceeded chronic and/or acute criteria

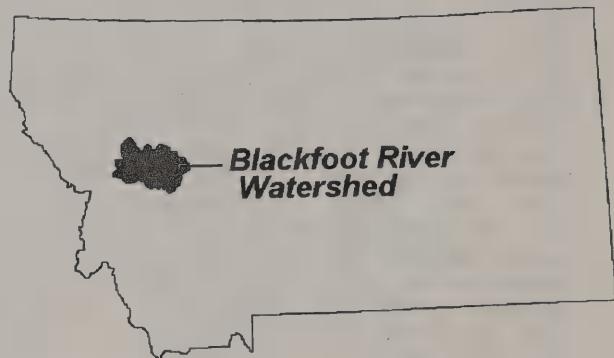


Figure 1. Blackfoot Basin Location Map.

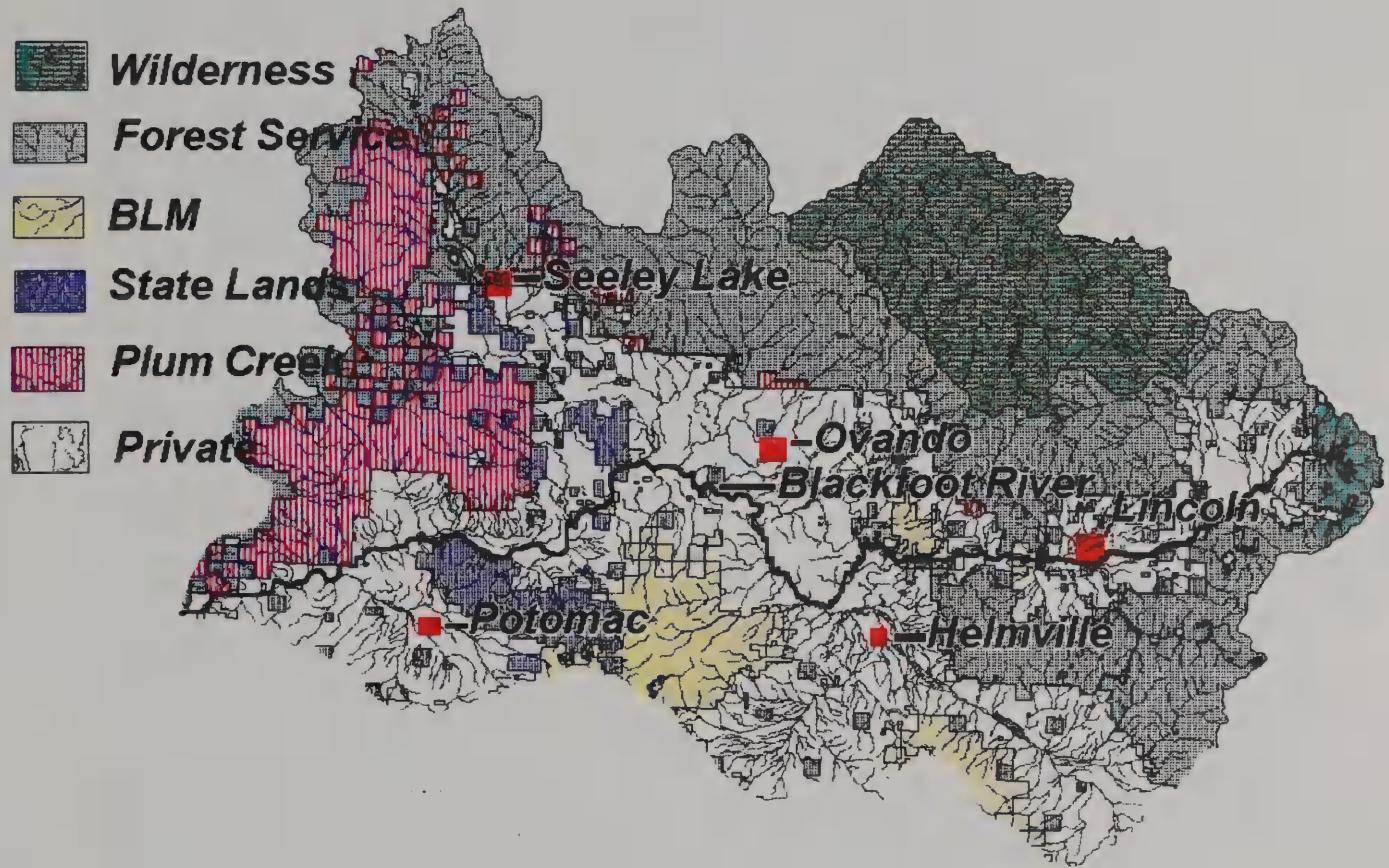


Figure 1a. Blackfoot River Drainage area.

in the upper river. Concentrations of toxins decline rapidly below the wetlands. However, the toxins do appear to be migrating through the wetland and continuing to contaminate additional stream mileage downstream (Moore et al. 1989 and Menges, 1997). A state Superfund voluntary clean-up is in progress on metals and acid water source areas. Toxic instream tailings have not been addressed by state agencies or the responsible parties since failure of the Mike Horse tailings pond in 1975.

The Blackfoot River loses water several miles downstream of these wetlands to alluvial outwash and is intermittent. Groundwater and spring creeks surface near Lincoln. Between Lincoln and Nevada Creek, river gradient gradually decreases to a low of 4 feet/mile, with a corresponding increase in sinuosity. Lateral migration of the channel forms point bars, cycling wood and sediment into the channel. Wood and undercut banks are primary habitat features in this river reach. Brown trout is the dominate game fish.

Nevada Creek, entering the mainstem at river mile 67.8, has been identified as a primary contributor of non-point pollutants to the middle Blackfoot River, such as nitrates, phosphates, sediment and elevated stream temperatures (Ingman 1990, Pierce 1991). Downriver of Nevada Creek, the river becomes entrenched and confined against the foothills of the Garnet Mountains by terminal moraines, creating a significant change in the physical habitat of

the river. Once confined, gradient increases from 4 to 15 feet/mile and lateral movement is restricted. The river loses sinuosity and assumes a pool/run sequence with cobble and boulder dominated substrates. Glacially erratic boulders replace undercut banks and woody debris as instream cover. With increasing gradient and channel roughness, turbulence and velocities increase. A transition from brown trout to a mixed fishery dominated by rainbow trout occurs in this section.

The North Fork of the Blackfoot River enters the mainstem at river mile 54.1, roughly doubling Blackfoot River flows. The cold-water influence of the North Fork reduces environmental stress, and improves water quality and species richness (McQuire 1988). The abundance of westslope cutthroat trout and bull trout increase downstream of this confluence.

As the mountains surrounding the lower Ovando Valley constrict, the broad upper Blackfoot Valley ends near the junction of the Clearwater River. Below the Clearwater River confluence at river mile 34.8, the Blackfoot River enters the lower canyon, where boulder runs that lead into deep bedrock pools are separated by cobble riffles or side channels divided by small islands. The Blackfoot River continues to flow through a narrow forested canyon to its confluence with the Clark Fork River, located 5 miles east of Missoula. The Blackfoot's average daily discharge is 1573 cfs; peak run-off averages 9235 cfs.

Blackfoot River Tributaries

The main east-west axis of the Blackfoot Valley separates distinct mountain blocks to the north and south of the river. These mountain blocks are further divided by secondary structural controls that trend southwest by northeast through the Nevada Creek and Clearwater River valleys; these controls create an irregular basin-and-range topography of four distinct mountain blocks.

In the northern mountain block east of the Clearwater River, streams originate in high alpine basins of Belt Rock geology. Most larger streams begin in cirques and flow south in glaciated valleys through vast areas of coniferous subalpine and montane forests. Significant portions of the region are roadless areas managed as wilderness. Streams exit the mountain block and enter Knob-and-kettle topography formed from glacial outwash and morainal deposits of the Ovando and Lincoln valleys. Near the mountain-valley interface, surface water in all major streams is usually lost to outwash deposits; some streams dewater at low-flow periods. Within a few miles downstream of the interface, these streams become perennial through groundwater recharge. Streams enter prairie and agricultural land. In these sections, physical and biological attributes of streams change, causing a shift toward a non-native fish assemblage. Principle tributaries of this region, in downstream order, are Alice Creek, Copper Creek, Landers Fork, Arrastra Creek, North Fork of the Blackfoot River, Monture Creek and Cottonwood Creek. The Landers Fork, North Fork of the Blackfoot River, Clearwater River and Monture Creek are the largest of the Blackfoot River tributaries, two of which originate in the Scapegoat Wilderness Area. The Clearwater River does not originate in wilderness, and is naturally influenced by the series of lakes through which it flows.

Streams north of the Blackfoot River and west of the Clearwater River originate in the same Belt Rock parent material, and have similar valley and stream types to those from the east; however, they do not enter glacial outwash or morainal deposits upon entering the Blackfoot Valley, and consequently are not significantly influenced by natural dewatering or groundwater. In contrast to eastern tributaries, these streams are perennial throughout their course and flow directly from high elevation mountains into the Blackfoot River. Land use in this region is dominated by commercial timber harvest. Tributaries to the Blackfoot River in this region, in downstream order, are Belmont, Gold, East Twin, and West Twin creeks.

To the south of the Blackfoot River, the Garnet Mountain Range is formed from two mountain blocks separated by the Nevada Creek Valley. This range is much lower in elevation than the northern side of the valley, with rounded and

mineralized mountains. Drainages in the region are smaller and yield much less water than streams to the north. These streams drain primarily montane to prairie environments. Land uses in the region include extensive mining and timber harvest in the mountains, and agriculture in the foothills. Principle tributaries, in downstream order, are Seven-up Pete, Poorman, Nevada, Chamberlain, Elk and Unions creeks.

From 1989 to 1996, fish population surveys have been completed on 52 Blackfoot River tributaries. Nineteen of the 52 were initially sampled in 1989 (Peters, 1990). A total of 47 tributaries were sampled in the Blackfoot River drainage from 1990 to 1996 (Appendix, Exhibit A), including 33 additional tributaries as well as continued monitoring on 14 of the 19 originally sampled in 1989.

Fish of the Blackfoot River Drainage

Twelve native fish and 12 to 13 nonnative fish occur in the Blackfoot River drainage, as well as hybridized cutthroat trout (rainbow trout, Yellowstone cutthroat trout crosses) and bull trout (brook trout crosses). Native fish are bull trout, westslope cutthroat trout, mountain whitefish, northern squawfish, longnose sucker, largescale sucker, sculpin (2 *Cottus* spp.), peamouth chub, pigmy whitefish, redside shiner and longnose dace. Non-native species are rainbow trout, brown trout, brook trout, Yellowstone cutthroat trout, arctic grayling, kokanee, northern pike, largemouth bass, yellow perch, pumpkinseed and white sucker. Other non-natives recorded in the basin include walleye and fathead minnow.

The Blackfoot River contains critical habitat for native species of special concern: fluvial bull trout and westslope cutthroat. The cold-water stream systems are dominated by salmonid fishes and are managed as wild trout fisheries with no fish planting.

Species composition and abundance of trout in the Blackfoot River and its tributaries vary greatly. Distributions are created by habitat, sources of recruitment for YOY, hybridization, human influences (such as environmental degradation and fishery exploitation), and interspecific competition. Distributions of the five main trout and char species in the drainage are briefly discussed here.

Bull Trout

In the Blackfoot River drainage, fluvial bull trout occur from the mainstem Blackfoot River to extreme headwaters of larger tributaries (Figure 2). Present distribution of fluvial bull trout is tied to larger tributaries draining mountains north of the Blackfoot River, although several smaller streams in the Garnet Mountains historically supported bull trout. Adfluvial populations occur in the Clearwater River drainage and the Coopers Lake drainage. Fluvial bull trout currently inhabit 420 miles of water or 22% of the total amount of perennial stream in the Blackfoot drainage.

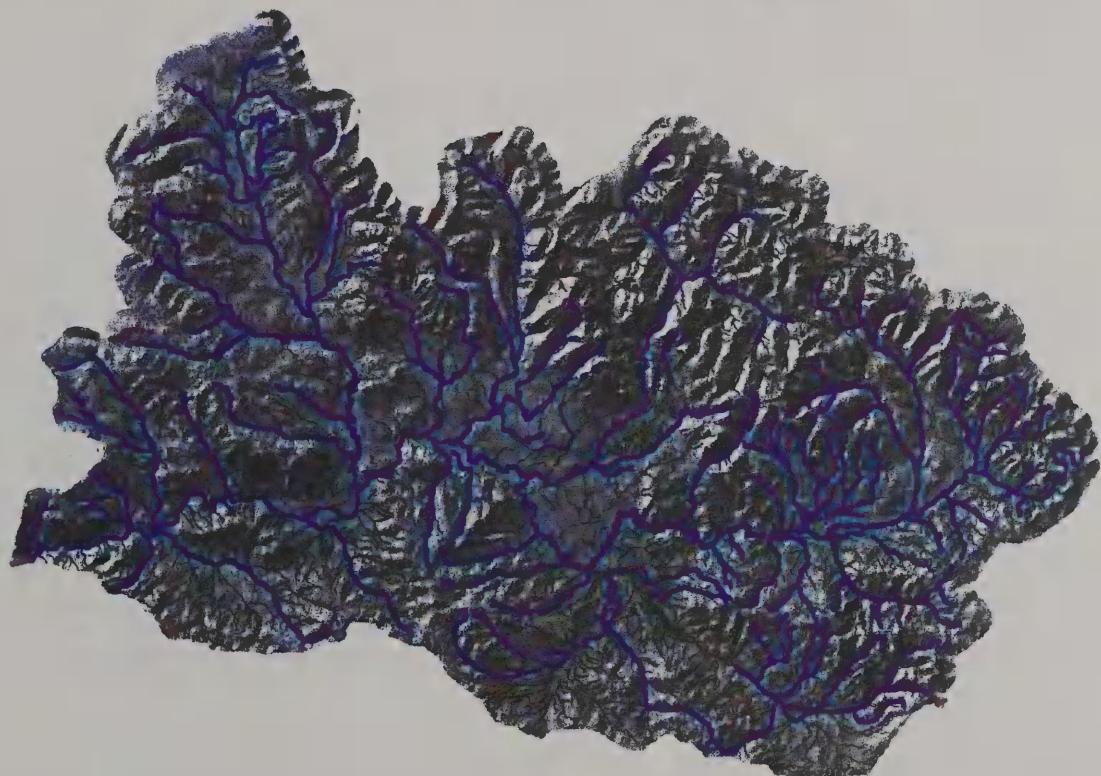
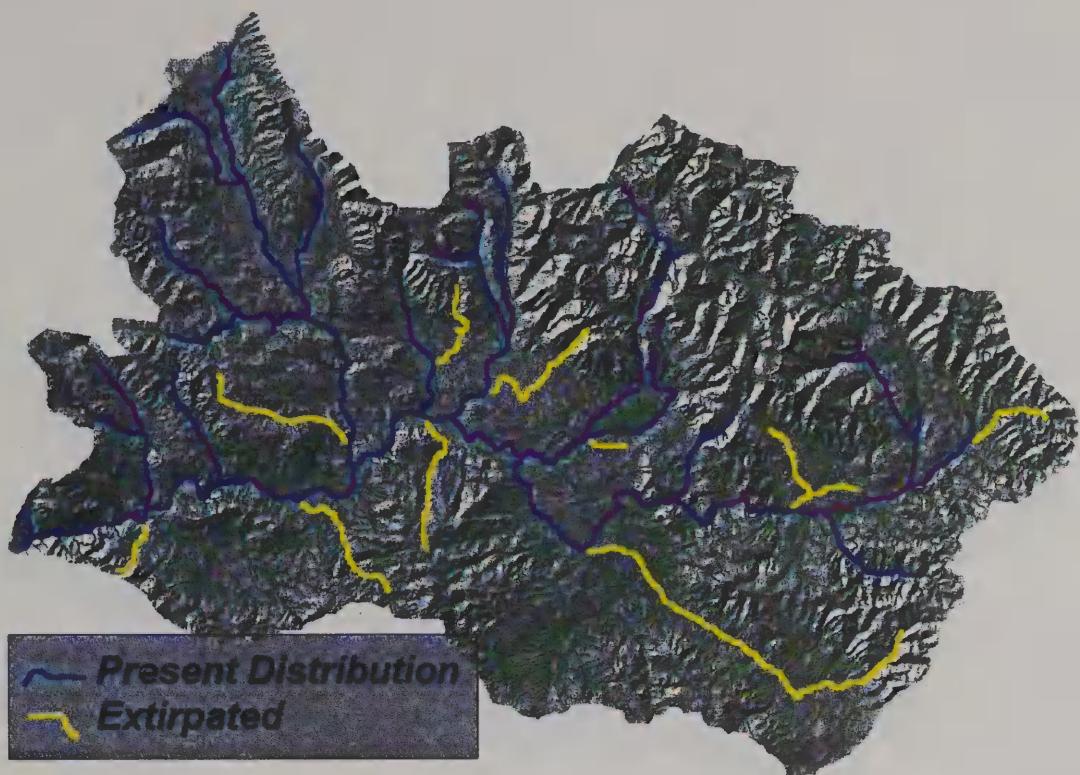
Westslope Cutthroat Trout

Cutthroat trout are distributed throughout the drainage, inhabiting the river and nearly all tributaries (Figure 3). Most tributaries support populations in headwater areas. In general, densities decline in the downstream direction; these declines are caused by hybridization, environmental degradation, historic fishery exploitation, and possibly from competition with non-native trout.

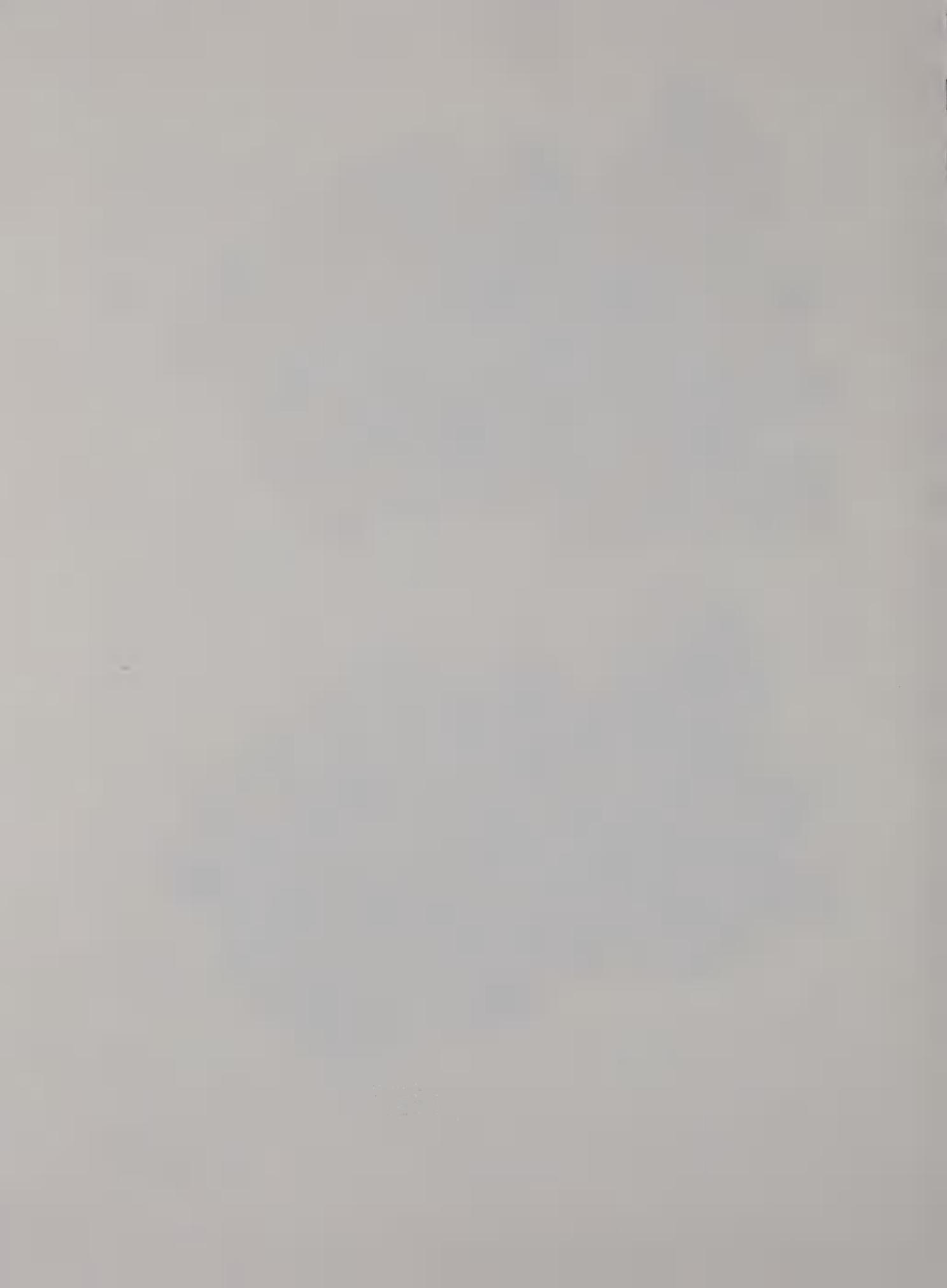
Other environmental variables, such as naturally intermittent stream sections and beaver activity, also may influence the distribution and densities of cutthroat trout in the drainage. Hybridization with rainbow trout has occurred in many tributaries to the lower river. Upriver of Nevada Creek no hybrids have been recorded, although some exist in tributaries to Nevada Creek upstream of Nevada Creek Reservoir.

Rainbow Trout

The distribution of rainbow trout in the Blackfoot River drainage is limited to the lower river and lower reaches of tributaries to the lower river



Figures 2 and 3. Bull trout (Top) and Cutthroat Trout (Bottom) Distribution Maps.



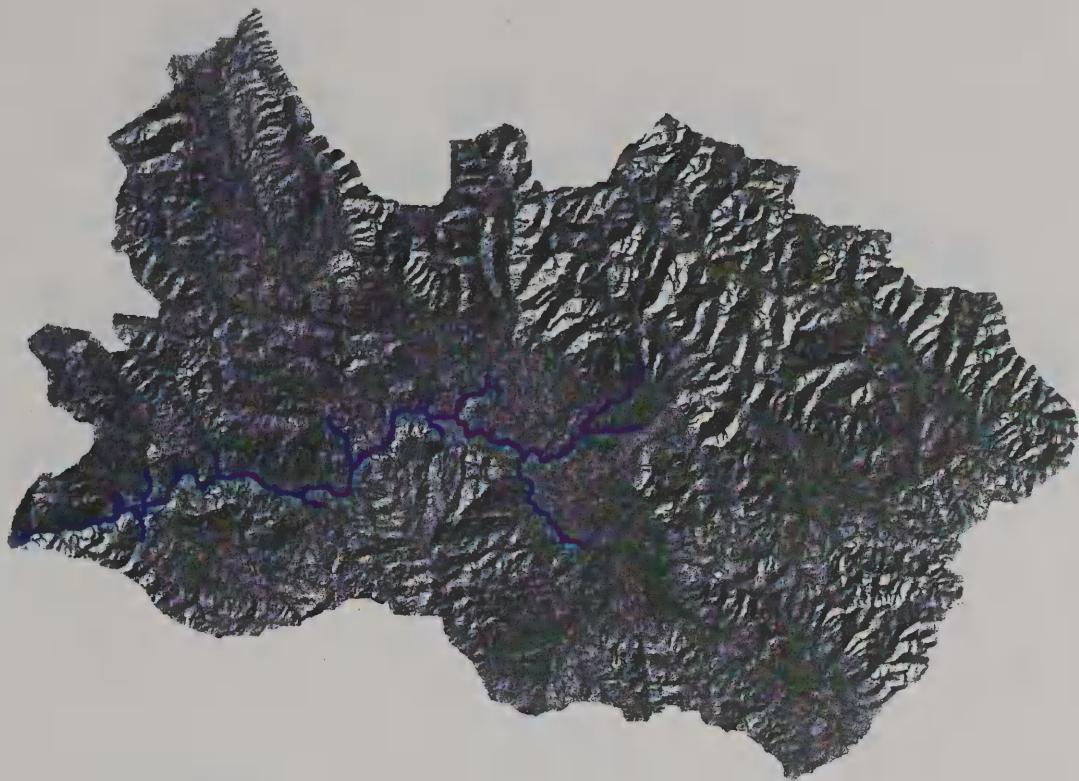


Figure 4. Rainbow Trout Distribution Map.

(Figure 4). Populations of rainbow trout in tributaries are generally comprised of juveniles, with highest densities in lower reaches. A significant number of YOY emigrate to the river during late summer after emergence from spawning areas. Densities of rainbow trout generally decline in the upriver direction, with the upper limit of the species in the area of Nevada Creek. This distribution is not explained by physical passage barriers. Rainbow trout inhabit 160 miles, or approximately 8%, of the perennial water in the Blackfoot Basin.

Brown Trout

Brown trout are more widely distributed in the drainage than rainbow trout, extending from the lower river to the upper Lincoln Valley (Figure 5). This fish inhabits stream reaches in the foothills and agricultural bottomlands of the Blackfoot Valley. Brown trout inhabit approximately 280 miles of stream or 15% of the total perennial network, including 110 miles of the Blackfoot River mainstem and the lower reaches of most tributaries. Under certain habitat conditions brown trout seem to dominate other species. Brown trout are generally considered more tolerant of elevated levels of sediment and temperatures than other species.

Brook Trout

Brook trout were first introduced to the Blackfoot River drainage on June 3, 1933 by stocking Elbow Lake in the Clearwater River drainage, based upon written planting records (Appendix, Exhibit L). Records indicate only 4 introductions of brook trout occurred in the Blackfoot drainage; two in Elk Creek (1946 and 1947) and one in Union Creek in 1946.

Brook trout are widely distributed throughout the Blackfoot River drainage, having been recorded in 38 of 52 tributaries sampled since 1989 (Figure 6). However, brook trout are rarely sampled in the Blackfoot River,

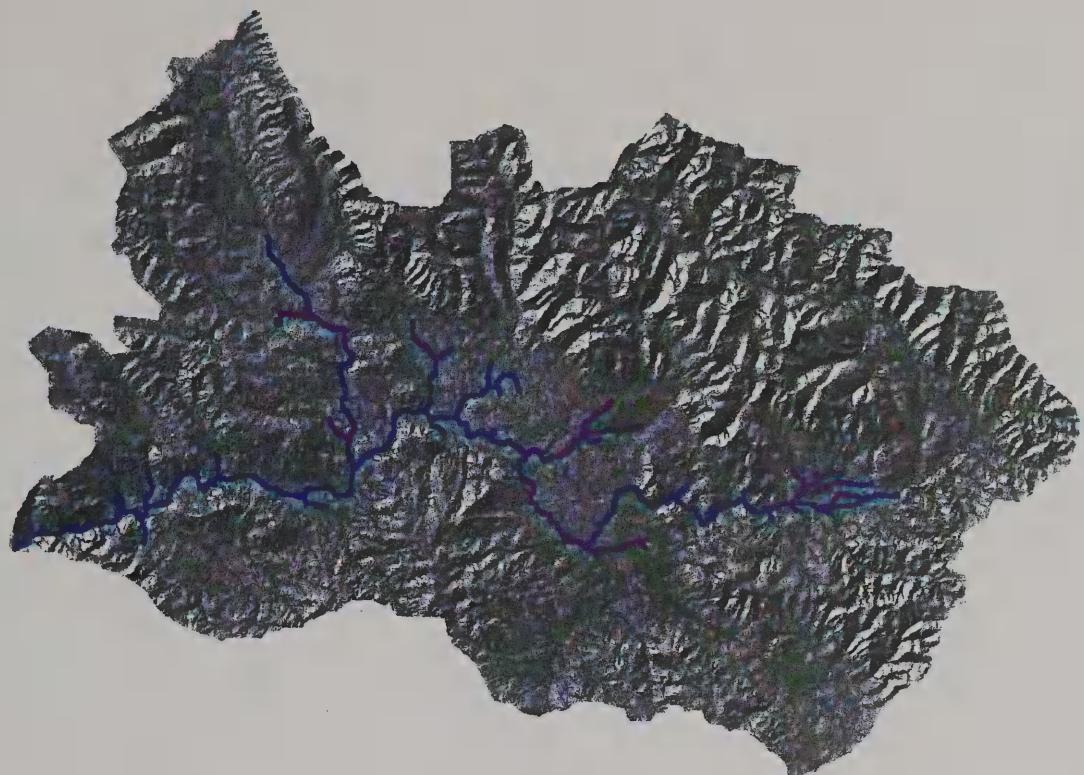


Figure 4 and 5. Brown Trout (Top) and Brook Trout (Bottom) Distribution Maps.

apparently doing poorly in this environment. Due to high reproductive rates and sediment tolerance, brook trout can do well in impaired streams. It may compete with native fish for space and food (Griffith 1972). Brook trout can hybridize with bull trout (Leary 1993). One brook x brown trout hybrid was captured in the North Fork of the Blackfoot.

METHODS

Working with Private Landowners

Restoration efforts in the Blackfoot River drainage focus on improving riparian habitats, stream connectivity and stream habitat in degraded streams. All projects are "cooperative solutions" between private landowners and the restoration team, and occur throughout the drainage. Restoration has focused on addressing obvious fishery impacts such as poor fish passage, stream dewatering, losses of fish to irrigation canals and degraded riparian areas. Addressing the source of stream degradation usually requires developing riparian/upland management options sensitive to the requirements of fish and current land uses. In the drainage of each tributary, multiple landowners, disciplines and resource recovery programs contribute to the restoration effort. All projects incorporate the needs of the private landowners, are voluntary, and are administered at the local level by a core group of "on-the-ground" technical resource experts in cooperation with private conservation organizations.

To begin a project, landowners are usually contacted by a fisheries and/or wildlife biologist on an informal, one-to-one basis (Figure 7). Landowner awareness of the habitat requirements of fish and their full participation in projects are considered crucial to the long-term success of restoration efforts. Although a large number of projects fixing damaged habitats have been put on the ground in the Blackfoot River drainage, the effort is still aimed at educating land managers and is far from complete. Cost-sharing for projects is arranged by project personnel. Written agreements with landowners to maintain projects are arranged with the cooperators on each project.

Administration of projects usually occurs at the field level, as well as through agency programs and/or through the Fisheries and Habitat Committee of BBCTU. Landowners are welcome to participate in all phases of the project, from problem identification to the collection of data and recovery efforts (Figure

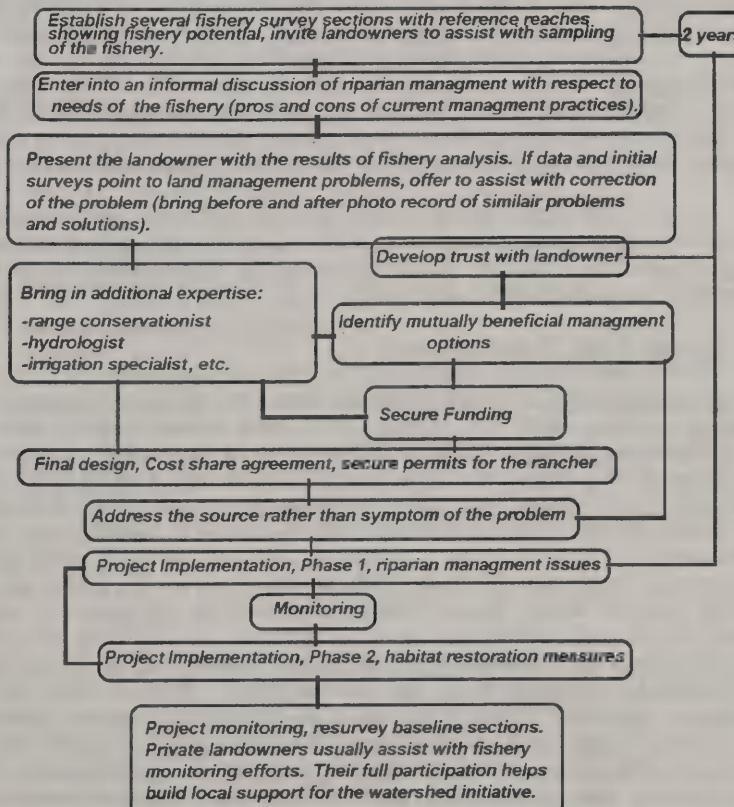


Figure 7. Flow Chart of Restoration Effort.

Figure 7. Flow Chart of Restoration Effort.

Landowners are welcome to participate in all phases of the project, from problem identification to the collection of data and recovery efforts (Figure

7).

The cooperative efforts include contributions from range conservationists, biologists, hydrologists and landowners in the design, supervision, and implementation of projects. The lead field biologist for the project normally handles environmental assessments, permits and helps identify cost-share options for the landowner.

Funding availability and flexibility contributes to restoration successes. Funding comes from many sources: private donations, foundation grants, state and federal agencies. BBCTU has been responsible for guiding and nurturing the overall cooperative effort. The FWS Partners for Wildlife Program is a primary supporter of the fishery initiative through funding and commitment to improving upland, wetland and riparian management. In recognition of upland areas as well as riparian sites, the North Powell Conservation District has also been expanding its outreach to landowners in the Nevada Creek watershed.

Channel Morphometrics and Restoration Techniques

Where habitat restoration involves stream channel reconstruction, our reconstruction techniques have evolved from relying largely on reference reaches to the techniques described by Rosgen (1996). The Rosgen classification of stream types and valley types combined with the techniques of determining channel geometry are generally accepted as the basis of defining morphologically stable streams. While the Rosgen techniques provide the methods for stable channel dimensions, we have modified the Rosgen techniques to include the addition of principle habitat features to the channel. Habitat restoration may include creating habitat complexity keyed to the naturally occurring drainage features, creating secondary habitats along stream banks like back-water areas or cut-off meanders, adding gravel to riffles, securing wood in the channel in a natural array of placements, and placing mature native shrubs along stream banks to provide shade and cover for fish.

Pre- and post-treatment photo points were taken at most project locations. More exhaustive habitat inventories were completed in six tributaries by Pierce (1991) using a modified version of the methods described by Hankin and Reeves (1988).

Monitoring Fish Populations

Fish were sampled with an electroshocker; the type of electroshocker used depended on stream size. In the small streams we used a gas-powered backpack unit, Coffelt Mark 10. The anode for this unit was a hand-held, 1-foot-diameter hoop; the cathode was a braided copper wire. We used an aluminum drift boat on the North Fork of the Blackfoot River and a jet-powered aluminum river boat on the Johnsrud and Scotty Brown Bridge sections of the Blackfoot River. A Coffelt Model VVP-15 rectifier and 5,000 watt generator were used in both boats. The hulls of both boats were used as cathodes and two booms, each with four cable droppers, served as anodes. We used direct DC current forms with less than 1000 watts of power, which is an established method to significantly reduce spinal injuries in fish associated with electrofishing. Young-of-the-year (YOY) trout were sampled in the tributaries from August to November in each year. Extra effort was used to sample stream edges and around cover to enable comparisons of densities between sampling sections. Captured fish were anesthetized with MS-222, measured for total length in mm (TL), and weighed to the nearest gram (g). Since most readers of this report are expected to be non-biologists, we converted all charts relating to size to inches (in.)

Population densities were calculated using single-pass, mark-recapture, or multiple-pass-depletion methods. The single pass catch-per-unit-effort (CPUE) or "catch-rate" statistic was calculated for all electro-sampling locations. CPUE calculates number of fish collected in a single electro fishing pass (or the first pass if multiple passes were made) and is adjusted per 100 feet of stream. Population densities using the mark-recapture method were estimated were using Chapman's modification of the Petersen formula

(Ricker 1975); confidence intervals were calculated with the Seber Formula (Seber 1982). Population densities using the multiple-pass-depletion method were calculated using Maximum likelihood estimators (Van Derventer and Platts 1983).

We continued long-term monitoring of the Scotty Brown Bridge (river mile 41.6 to 45.9) and Johnsrud (river mile 11.0 to 15.3) sections of the Blackfoot River. In 1989, we also established a population monitoring section on the lower reach of the North Fork of the Blackfoot River. Electrofishing surveys were duplicated on six streams first sampled in 1989 to monitor the effects of harvest restriction and fishery enhancement measures.

Bull Trout Redd Surveys

The number of bull trout redds were annually surveyed in Monture Creek and nearly annually in the North Fork of Blackfoot River from 1989 to 1996. Counts were made by walking the stream bank of indexed spawning areas in late September of each year. Redd areas were identified by the "cleaned", oval shape, and upper redd depression left by the female bull trout's digging activities. Using the same technique, all locations in the drainage likely to contain spawning were surveyed in 1996 including: Belmont, Copper, Cottonwood, Dunham, Gold, Lodgepole, and Monture creeks, and the North Fork Blackfoot River [Appendix, Exhibit J].

Telemetry

The movement and habitat use of bull trout in the Blackfoot River were studied from 1994 to 1996 (Swanberg 1996). Some results from this study are presented in this report as they apply to restoration efforts. A detailed description of the methods used in this project are presented in Swanberg (1996). Briefly, bull trout were captured and implanted with transmitters in the Blackfoot River. Fish were tracked during migrations more than three times/week from the air and ground and less frequently at other times of year.

Monitoring Water Temperature

From 1994 to 1996, water temperatures were recorded at 48-minute intervals at 23 stations in the Blackfoot River drainage using Hobo Temp and Stowaway data loggers (Figure 8). Data for each station were summarized with daily maximum, minimum and average temperatures.

Stream Flows

From 1989 to 1996, 48 measurements of stream discharge were taken in 27 tributaries. Additionally, 24 measurements were made in 10 irrigation canals (Appendix, Exhibit H). All data were collected with a Marsh-McBurney flow meter using the protocol developed by the U. S. Geological Survey (Shield 1985). Fifty-seven years of daily mean flow records at the USGS gage near Bonner (station no. 12340000) were analyzed to determine relative flow conditions in the Blackfoot River.

Blackfoot River imagery

High resolution multispectral digital imagery, captured the Blackfoot River, lower Monture Creek, North Fork Blackfoot River and Nevada Creek. Most flight lines have been georeferenced and are now compatible with GIS. The data provide a baseline condition of land use, riparian vegetation, and stream channel pattern and profile dimensions. Imagery maps have provided a base layer for inventories of riparian health as described in Hansen et al. (1995) for Nevada and Monture creeks. Specifications of the imagery are in the Appendix, (Exhibit I).

RESULTS/DISCUSSION

Fishery inventory and restoration results/discussion are alphabetically organized within four categories. Part I summarizes the stream discharge and

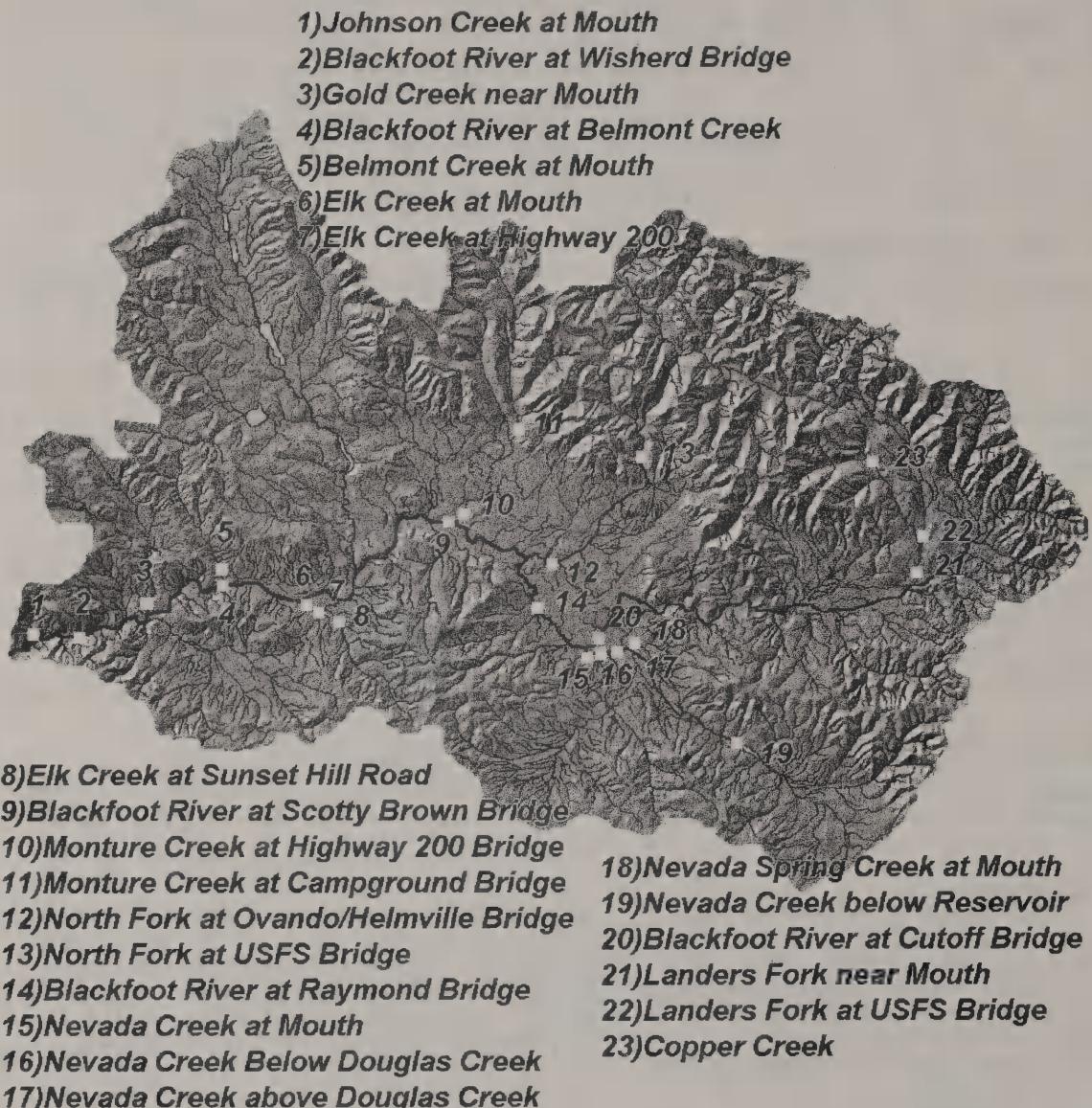


Figure 8. Location Map of Water Temperature Monitoring Sites in the Blackfoot Basin.

temperature factors of the Blackfoot River environment along with fisheries monitoring in the Johnsrud and Scotty Brown Bridge sections of the Blackfoot River. Part II summarizes results of restoration projects and fish surveys that occurred in "core" bull trout drainages. Part III details restoration efforts, and monitoring of fish populations and stream habitat in critical cold-water streams not considered core bull trout drainages. Lastly, Part IV presents results of fish surveys in drainages that have not had restoration activities, but which may in the future.

Monitoring objectives were to 1) document changes in the composition and densities of fish resulting from restoration efforts; 2) document changes in land practices using photographic records and electronic multispectral imagery of the Blackfoot River corridor; 3) identify tributaries with thermal conditions favorable and unfavorable for trout, particularly native species; 4) establish additional tributary baseline information; and 5) identify future projects for fishery restoration.

RESULTS: PART I

Blackfoot River Environment

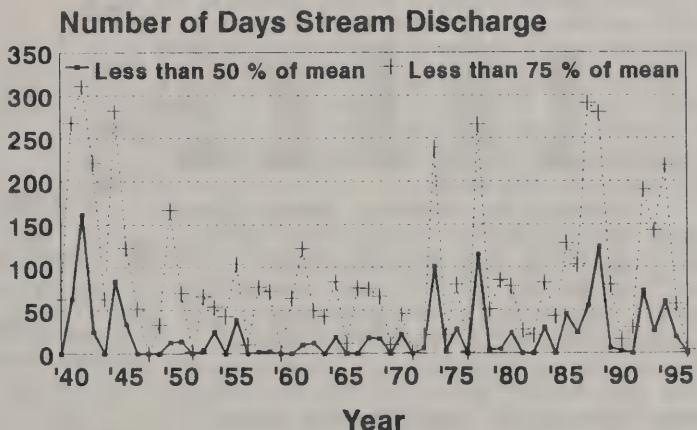
Stream Discharge

The Blackfoot River has experienced two significant "environmental events" in the 1990's that have influenced fish habitat and probably fish populations. The first event was the continuation of a record setting drought and the second event a large "ice-flow" many times larger than normal for the river.

Fifty-seven years of stream discharge records (1939 to 1996) at the USGS gaging station on the Blackfoot River near Bonner were analyzed to determine the severity of the drought. In 8 of the last 12 years (1985-1996), daily mean stream discharge was less than 50% of the average daily flow for 25 days or more (Figure 9). Four near average years occurred in 1989, 1990, 1991 and 1996.

The February 1996 "ice-flow" that moved 60 miles down the Blackfoot River from Nevada Creek to the town of Milltown significantly altered habitat and fish populations. The movement of the ice-flow destroyed one bridge, lifted an 80 year old home from its foundation and left 10 to 15 foot high "ice-walls" along the river channel. Near shore zones inhabited by juvenile fish were subjected to considerable grinding action by ice and moving cobble substrates. The extensive use of these intragravel near-shore environments during the winter periods has been well documented for rainbow and brown trout in western Montana.

In addition, significant losses of the sandbar willow *Salix exigua* the dominant woody shoreline vegetation, occurred along the entire reach. Sandbar willow stands were reduced from 50 to 90% of previous densities (based upon visual estimates in long-term fish sampling sections from 8 miles of river). This "edge" vegetation on the Blackfoot River is the primary refuge for fish during peak discharge periods. Flood waters produce water velocities in most of the Blackfoot River channel in excess of fish's ability to maintain themselves over extended periods. The dense sandbar willow stands provide areas with greatly reduced current



Data from USGS Station 12340000

Figure 9. Blackfoot River Relative Drought Conditions near Bonner: Number of Days Stream Discharge at USGS Station 12340000 was less than 50% and 75% of the Daily Mean for the Period of Record, 1939 to 1996.

velocity and cover in the Blackfoot River's entrenched, narrow channel.

River Temperatures

Summer water temperatures have been monitored at five sites in the Blackfoot River since 1994 (Figure 8). The maximum temperature recorded during this monitoring was 72° at Raymond Bridge, 7.5 miles downstream of the Nevada Creek confluence. Daily maximum temperatures in the Blackfoot River exceeded 68° F at three of the Blackfoot River temperature monitoring stations: Wisherd bridge, RM 6.2, Scotty Brown bridge, RM 44.0, and Raymond Bridge, RM 58.1 (Figure 10). The Raymond bridge site exceeded 68°F for 25 out of 141 sampled days between June and October during the summers of 1994, 1995 and 1996. Daily maximum temperatures in the Blackfoot River exceeded 60°F at all 5 stations. The worst exceedences occurred at Raymond bridge, Scotty Brown bridge and Wisherd bridge, respectively exceeding 60°F 98, 91, and 86 days of sampling from 1994 to 1996.

Mean summertime temperatures at Raymond bridge were consistently higher than the Helmville cut-off sampling station 9.7 miles upstream (Figure 11). Generally, the warming of this reach of the river occurs in July and August. The Belmont Creek sampling site on the Blackfoot River exceeded average temperatures of all other sites during the cooler months in 1995. Monthly average temperatures in the Blackfoot River did not exceed 64°F.

Generally, average summer water temperature, which was 60°F upstream from the Nevada Creek confluence (RM 67.8), was warmed by Nevada Creek to 64°F (Raymond Bridge, RM 58.1), was then cooled 5°F by contributions of cold water from the North Fork of the Blackfoot River (RM 51.8) and Monture Creek (RM 44.2), and then gradually warmed downstream to 61°F at Wisherd Bridge (RM 6.2). Additional temperature Summary data is located in the Appendix, (Exhibit G).

Blackfoot River Fish Populations

Johnsrud Section

The composition of trout species in 1996 in the Johnsrud Section was 72.3% rainbow trout, 18.7% brown trout, 6.0% cutthroat trout and 2.9% bull trout. Four spring surveys of fish populations

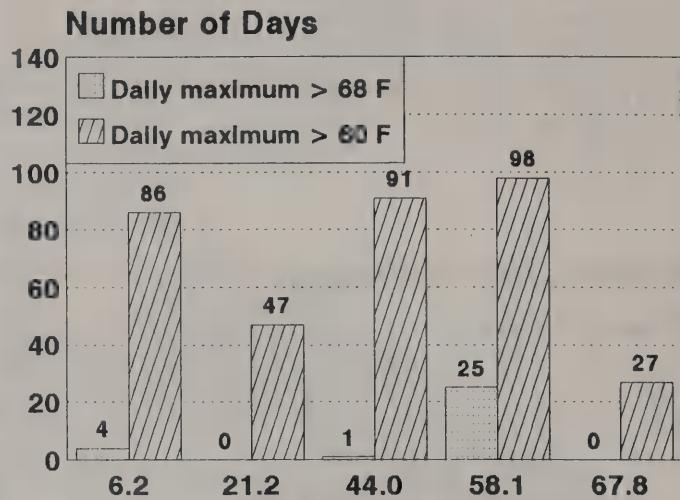


Figure 10. Maximum Temperature Exceedence of 60 and 68 Degrees F at 5 River Locations.

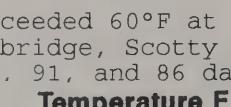


Figure 10. Maximum Temperature Exceedence of 60 and 68 Degrees F at 5 River Locations.

Temperature F

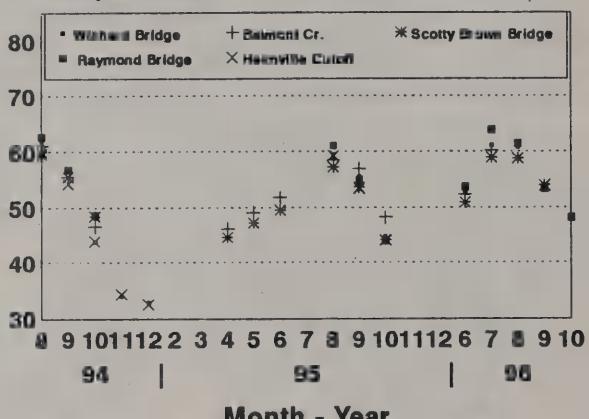


Figure 11. Blackfoot River Mean Monthly River Temperatures at 5 Locations Sampled in 1994, 1995 and 1996 by FWP.

Figure 11. Blackfoot River Mean Monthly River Temperatures at 5 Locations Sampled in 1994, 1995 and 1996 by FWP.

occurred in the Johnsrud section since 1989, one in 1990, 1991, 1993 and 1996. Estimated densities of rainbow trout 5.0 to 9.9 in. TL were decreasing although relatively stable from 1989 to 1993, ranging from 177 to 76 fish/1000 ft (Figure 12). A significant departure occurred in the 1996 with the estimated density of 5.0 to 9.9 in. TL rainbow trout declining to 28 fish/1000 ft. Densities of rainbow trout 10.0 to 11.9 in. TL were generally stable from 1989 to 1993, ranging from 20.8 to 28.9 fish/1000 ft. Our estimates in 1996 revealed a significant decline in densities to 3.3 fish/1000 ft. Estimated densities of rainbow trout ≥ 12.0 in. TL have fluctuated during the period 1989 to 1996 from a low of 9.6 fish/1000 ft in 1990 to a high of 29.7 in 1991. Estimated densities of rainbow ≥ 12.0 in. TL declined significantly from 1993 to 1996 with densities going from 29.5 to 12.2 fish/1000 ft.

From 1990 to 1993, combined densities of cutthroat trout, bull trout and brown trout ≥ 6.0 in. TL doubled from 14.9 to 30.2 fish/1000 ft, but then declined to 14.4 fish/1000 ft between 1993 and 1996 (Figure 13).

Densities of cutthroat trout and bull trout ≥ 6.0 in. TL increased from 1990 to 1991 from 3.6 to 11.8 and 1.4 to 4.2 fish/1000 ft, respectively. The 1993 survey recorded a slight decline in numbers of both native species. The 1996 survey recorded a sharp decline in

densities of both species between the 1993 and 1996 surveys. In 1996, cutthroat trout densities fell to 31% of the 1993 level, with densities declining from 11.8 to 3.7 fish/1000 ft. The estimated 1996 bull trout estimate showed a similar decline, with densities 35% of 1993, 2.3 fish compared to 0.8 fish/1000 ft in 1993 and 1996, respectively. Brown trout showed a similar pattern of decline between 1993 and 1996. Densities of fish ≥ 6.0 in. TL increased from 8.8 to 17.9 fish/1000 ft between 1990 and 1993, but then declined 45% to 9.9 fish/1000 ft in 1996.

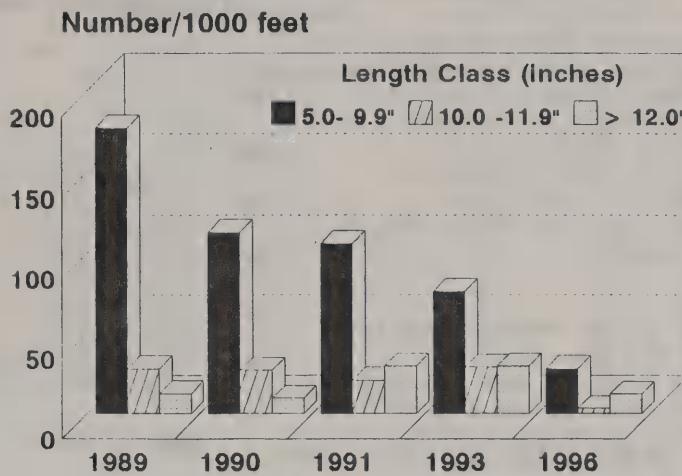


Figure 12. Estimated Densities of Rainbow Trout in the Johnsrud Section of the Blackfoot River, 1989 and 1996.

Estimated densities of rainbow ≥ 12.0 in. TL declined significantly from 1993 to 1996 with densities going from 29.5 to 12.2 fish/1000 ft.

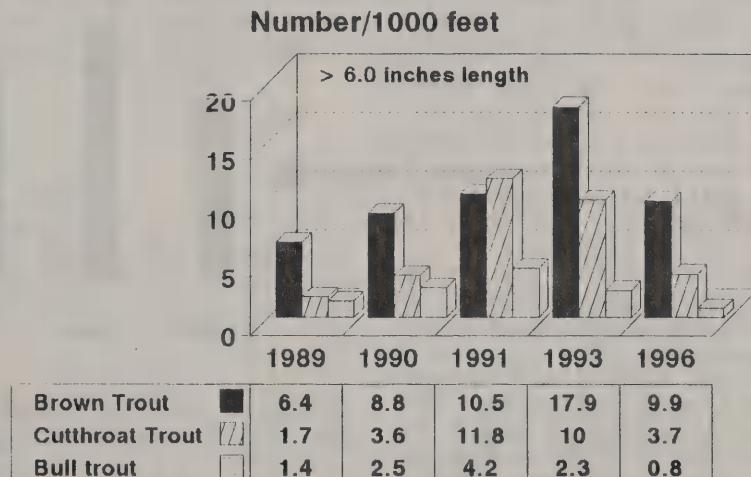


Figure 13. Estimated Densities of Bull, Cutthroat and Brown Trout in the Johnsrud Section, 1989 and 1996.

Estimated densities of both species between the 1993 and 1996 surveys. In 1996, cutthroat trout densities fell to 31% of the 1993 level, with densities declining from 11.8 to 3.7 fish/1000 ft. The estimated 1996 bull trout estimate showed a similar decline, with densities 35% of 1993, 2.3 fish compared to 0.8 fish/1000 ft in 1993 and 1996, respectively. Brown trout showed a similar pattern of decline between 1993 and 1996. Densities of fish ≥ 6.0 in. TL increased from 8.8 to 17.9 fish/1000 ft between 1990 and 1993, but then declined 45% to 9.9 fish/1000 ft in 1996.

Whirling disease fish samples were collected immediately downstream of the Johnsrud section near West Twin Creek. Sixty-one age 1 and age 2 rainbow trout were collected on April 18, 1995 (Appendix, Exhibit K). Whirling disease was not detected in this sample.

Scotty Brown Bridge Section

The Scotty Brown Bridge section was sampled in the same years as the Johnsrud section (1989, 1990, 1991, 1993 and 1996). In 1996, the composition of the fishery was 48.7% rainbow trout, 26.2% brown trout, 20.8% westslope cutthroat trout and 4.3% bull trout.

The 1990, 1991 and 1993 estimated densities of the trout population ≥ 6.0 in. TL were stable, respectively 87.2, 83.0 and 79.7 fish/1000 ft (Figure 14). The 1996 total trout densities for fish ≥ 6.0 in. TL declined 28% from 79.7 in 1993 to 57.8 fish/1000 ft. The decline reflects reduced numbers of rainbow trout in the small to intermediate size classes. Between 1990 and 1993, rainbow trout densities in the 4.0 to 10.9 in. size class declined from 41.8 to 26.6 fish/1000 ft (Figure 15). The 11.0 to 13.9 in. size class appeared stable with densities ranging from 13.3 to 19.8 fish/1000 ft. However, in 1996 the 11.0 to 13.9 in. size class declined to 4.1 fish/1000 ft, and the 4.0 to 10.9 size class declined to 10.5 fish/1000 ft. Estimates for large rainbow trout ≥ 14.0 in. TL increased 266% from 5.9 to 15.7 fish/1000 ft from 1990 to 1993; however 1996 densities declined to 10.6 fish/1000 ft.

Estimated densities of bull trout ≥ 6.0 in. TL fluctuated between 1.5 and 2.9 fish/1000 ft from 1989 to 1996 (Figure 16). Low densities of bull trout make accurate estimation of densities difficult. However, the estimates we have obtained under these conditions appear to be trending upward. The estimated density of bull trout ≥ 6.0 in. TL has increased 57% from 1.5 in 1990 to 2.6 fish/1000 ft in 1996.

Estimated densities of cutthroat trout ≥ 6.0 in. TL increased significantly in the Scotty Brown Section from 1989 to 1996 (Figure 17). In

Number/1000 feet

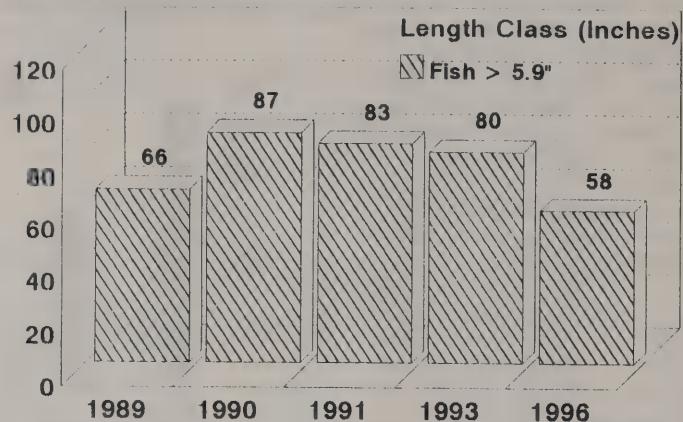


Figure 14. Estimated Densities of All Trout ≥ 6.0 in. TL for the Scotty Brown Bridge Section, 1989 to 1996.

Number/1000 feet

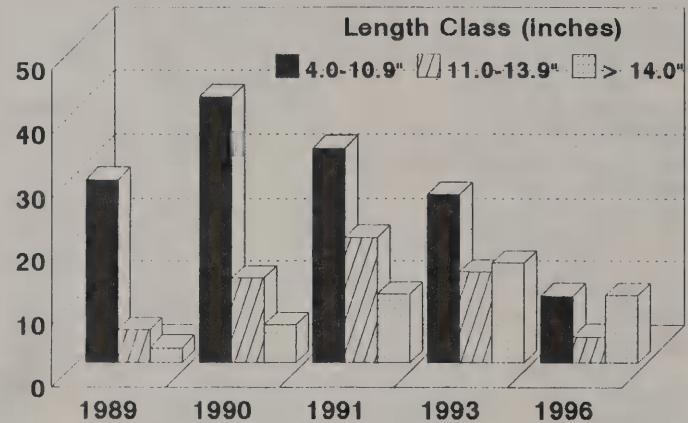


Figure 15. Estimated Densities of Rainbow Trout in the Scotty Brown Bridge Section, 1989 to 1996.

particular, estimated densities of cutthroat trout ≥ 12.0 in increased 730% from 1.0 in 1990 to 7.3 fish/1000 ft in 1996 (Appendix, Exhibit B). The length frequency of our electrofishing catch of cutthroat has changed significantly from 1989 to 1996 (Figure 18). We are generally capturing more larger cutthroat trout. However, no change in our catch of small cutthroat (< 6.0 in. TL), has occurred (Appendix, Exhibit B).

We were unable to obtain an adequate sample for a density estimate for brown trout in 6.0 to 11.9 inch class in 1996. Brown trout in the 6.0 to 11.9 in. length class had an estimated density increase of 68% in 1993, relative to 1990, respectively 13.0 and 8.9 fish/1000 ft (Figure 19). From 1990 to 1996, numbers of larger brown trout ≥ 12.0 in. TL improved 94% with densities increasing from 3.6 to 6.8 fish/1000 ft.

Whirling disease samples were collected from the Blackfoot River in September and November of 1995 at the upper end and the lower end of the Scotty Brown Bridge section. All samples tested negative for whirling disease from the 104 juvenile rainbow and 16 juvenile brown trout.

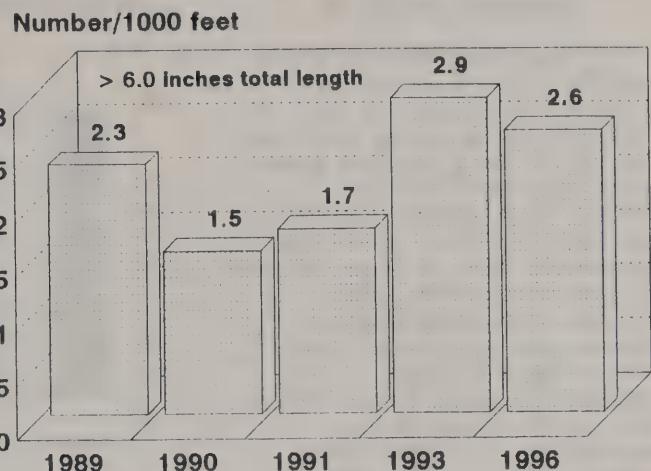


Figure 16. Estimated Densities of Bull Trout in the Scotty Brown Bridge Section, 1989 to 1996.

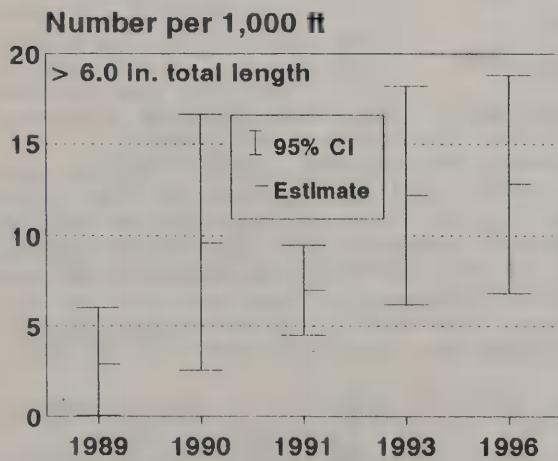


Figure 17. Estimated Densities of Cutthroat Trout Densities in the Scotty Brown Bridge Section, 1989 to 1996.

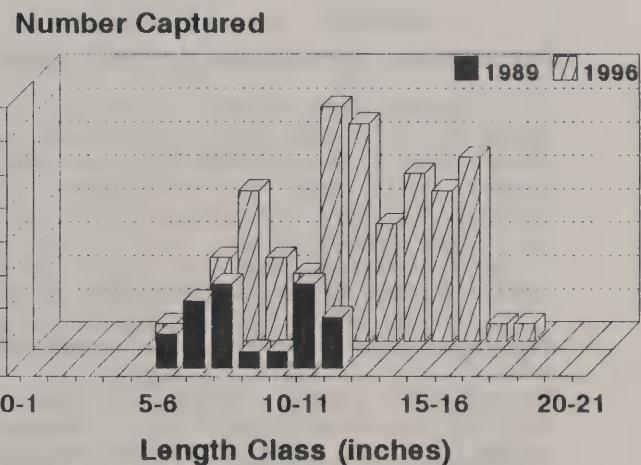


Figure 18. Length Frequency of Cutthroat Trout Captured Electrofishing in the Scotty Brown Bridge Section, 1989 and 1996.

RESULTS: PART II

The analyses of fish population densities in Results Part II, III and IV rely on two general methods. The first is a single pass catch-per-unit-effort (CPUE), the second is a population density estimate generated from a 2 or 3 pass depletion survey (see Methods Monitoring Fish Population section). We used simple linear regression to analyze the degree of association between the two methods (Figure 20). The results indicate a close relationship between the two methods, $r^2 = 0.902$, $p < 0.0001$. Consistently small stream size and highly efficient electrofishing conditions in our study streams contributed to this outcome. Although the model demonstrates CPUE to be an index to population density, CPUE does not include a confidence interval like the actual population density estimate.

In the following sections of this report, CPUE in all cases refers to number of fish collected in a single electrofishing pass and is adjusted per 100 ft of stream (ie. CPUE of 8 means 8 fish collected per 100 ft of sampled stream). Actual population estimates are referred to as density/100 ft. The 95% confidence intervals for these estimates are found in Appendix (Exhibit C).

Number/1000 feet

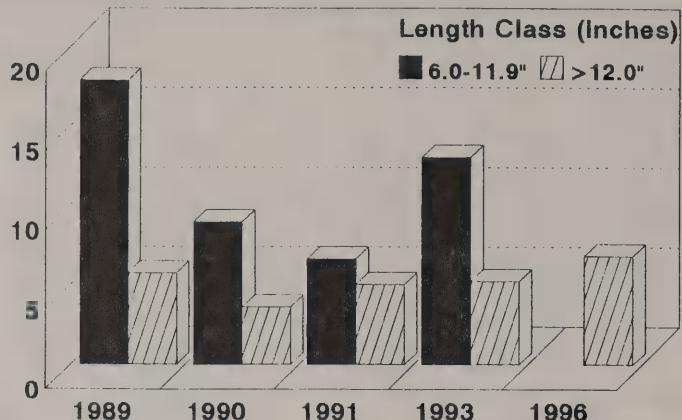


Figure 19. Estimated Densities of Brown trout in the Scotty Brown Bridge section, 1989 to 1996.

Restoration Activities in Bull Trout Core Streams

Seven watersheds to the Blackfoot River have been identified as core areas for the recovery of fluvial bull trout by the Montana Bull Trout Scientific Group (1995). The core area streams are Belmont, Cottonwood, Copper, Gold, and Monture creeks, and the Landers and North Forks of the Blackfoot River (Figure 21). Five of these streams have had habitat enhancing projects completed on them since 1990. Special research efforts designed to identify habitat use and migration patterns of bull trout with the use of radio telemetry have also been completed since 1993.

Fifty-three radio-tagged bull trout were tracked in the Blackfoot River drainage from 1994 to 1996. Radioed bull trout have entered five of the core area watersheds: Copper, Gold and Monture creeks, and the North Fork and Landers Fork of the Blackfoot River. Spawning by radio-tagged fish has occurred in three of these streams: Monture and Copper creeks and the North Fork of the Blackfoot River. No radio-tagged bull trout from the lower Blackfoot River have been tracked above the confluence of the North Fork Blackfoot River, suggesting separate populations exist in the upper and lower drainage. Extensive use of the Blackfoot River has been documented by the researchers tracking the radioed fish (Swanberg 1996).

Surveys of spawning bull trout or redd surveys have been completed on a regular basis in three of the more significant spawning streams that remain in the drainage: Copper and Monture creeks, and the North Fork of the Blackfoot River. The trend information is included with each stream's results in the

following sections. In 1996, a more thorough survey was undertaken that included streams and reaches in all core areas and other reported bull trout streams. The total number of redds counted in this survey was 198 (Figure 22). Seventy percent of the counted redds occurred in Monture Creek and the North Fork of the Blackfoot. Eighteen percent of the redds occurred in Copper Creek (Appendix, Exhibit J).

We have intentionally limited genetic evaluations of bull trout populations in the Blackfoot River due to the low fish densities (even among the best populations) and to the lethal nature of the tests. New non-lethal sampling techniques are being developed and will be incorporated into future sampling. Genetic tests using electrophoretic techniques were completed on juvenile bull trout from the North Fork of the Blackfoot River, Belmont Creek and Copper Creek by the University of Montana's Fish Genetics laboratory. A report of their findings occurs in the results for each stream and the Appendix, Exhibit F. The tests indicated all populations were pure bull trout and were genetically similar to one another. However, the tests for similarity between the populations was weak at best (Leary 1996).

Belmont Creek

Belmont Creek, a second-order stream, flows south approximately 11 miles before entering the Blackfoot River at mile 21.9. Its base flow measured 13 cfs near the mouth in August 1989. The channel is generally stable, containing small rapids and irregularly spaced scour pools. Substrate is mainly boulder and cobble, with lesser amounts of gravel and elevated levels of fine sediment. The Belmont Creek watershed supports an industrial forest, with 92% of the watershed owned by Plum Creek Timber Company.

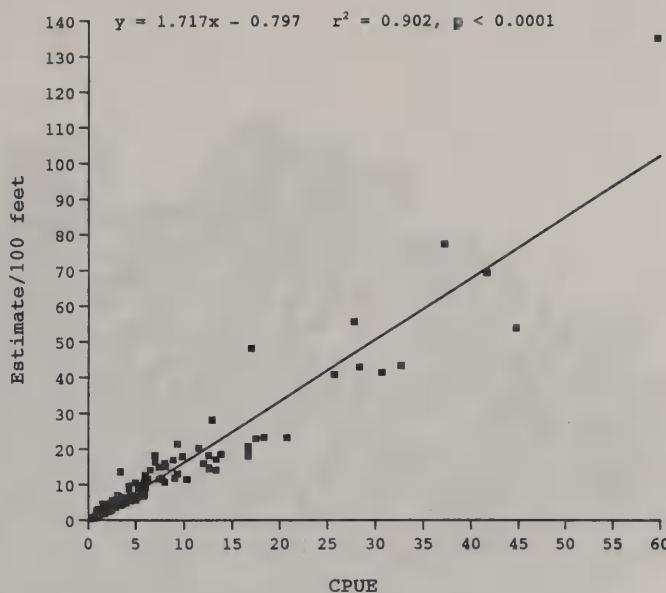


Figure 20. CPUE/Estimation Regression: Association Between CPUE and Populations Estimates of Trout Sampled in Blackfoot River Tributaries, 1990 to 1996.

Number of Redds Observed

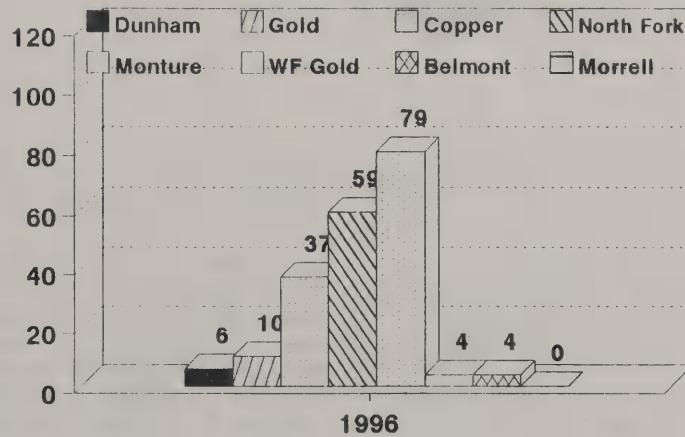


Figure 22. Number of Bull Trout Redds Observed in Known Bull Trout Spawning Streams in the Blackfoot River Basin in 1996.

INTRODUCTION

CONTINUATION

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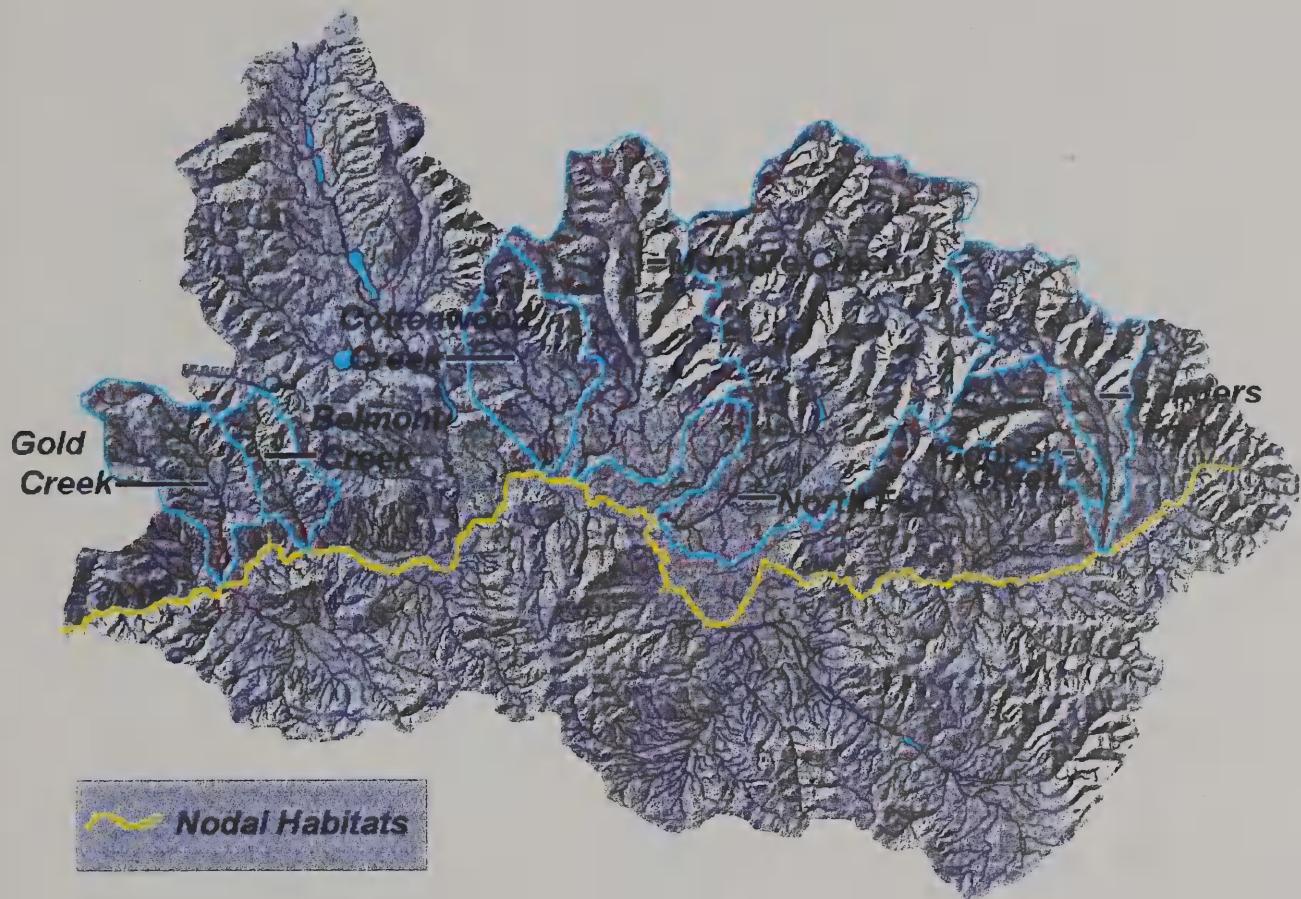


Figure 21. Map of Fluvial Bull trout Core Streams (Watersheds) and Nodal Habitats for the Blackfoot Watershed.

Belmont Creek has been identified as "water quality impaired" by the State of Montana (MDHES 1994). The drainage, containing 135 miles of road, has road drainage problems that contribute sediment to the stream. Rothrock (1996) estimated an erosion rate of 1.6 tons of soil/acre/year from the drainage, four times the amount of Monture Creek, a reference stream.

Two undersized culverts were placed in Belmont Creek in the 1960's that seasonally blocked the upstream movements of spawning fish. Concentrations of rainbow trout and bull trout were documented below the culverts from 1974 to 1990 (Montana Department of Fish, Wildlife and Parks, unpublished data). The large amount of fill placed over the culverts and the difficulty to place a bridge at the site prolonged a solution to the problem.

Summer water temperatures have been monitored during the summers of 1995 and 1996 near the mouth of Belmont Creek. Maximum daily temperatures were below 62°F in each year (Figure 23). Daily minimum temperature reached the 32°F range in November.

Restoration objective

- 1) Restore access to the lower 5 miles of the stream for spawning trout.
- 2) Improve road drainage.

3) Improve livestock grazing practices.

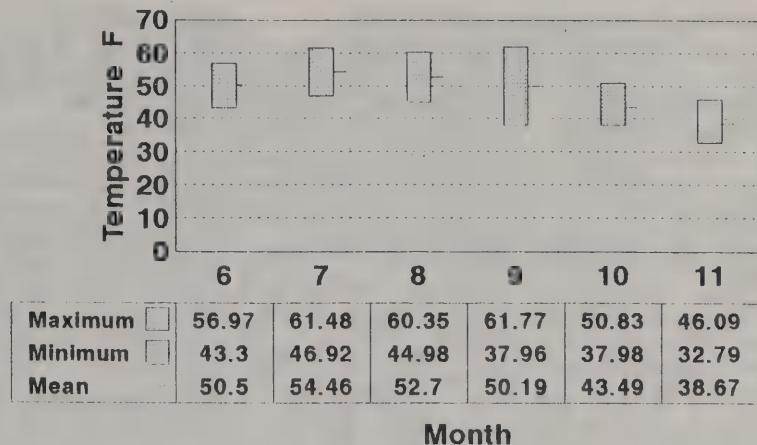
Restoration activity

In 1993 a bridge was constructed 0.25 mile upstream of the culvert and the culvert removed. Plum Creek Timber Company has developed and committed to an extensive restoration/sediment control design for the drainage. Initial elements to the project included road closures and initiating grazing BMP's on riparian areas.

Fish Populations

Rainbow trout dominate the fishery in the lower three to four stream miles of Belmont Creek; high densities of juveniles occur in lower reaches (Figure 24). Densities of brown trout increase in lower reaches and bull trout also occur here. Cutthroat trout occur upstream of stream mile four. Only one brook trout has been recorded in the drainage. That fish was captured at stream mile 0.6 in September 1994 and removed. Belmont Creek, the North Fork of the Blackfoot River and Copper Creek are the only three streams where bull trout spawn and brook trout are absent in most reaches.

Above stream mile six, Belmont Creek supports an all native fish assemblage of cutthroat trout, bull trout, and sculpin (Peters 1989).



Period of Record 6/95 - 9/96

Figure 23. Belmont Creek Temperature Summary.

Number of fish/100 ft

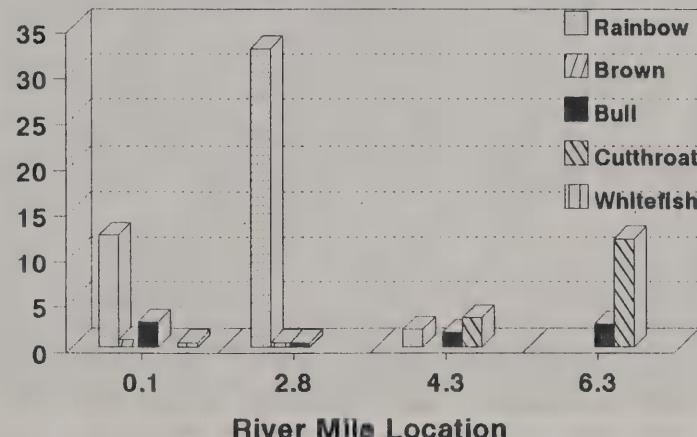


Figure 24. Electrofishing Catch per 100 feet at 4 Locations in Belmont Creek in July 1989.

Number of fish/100 ft

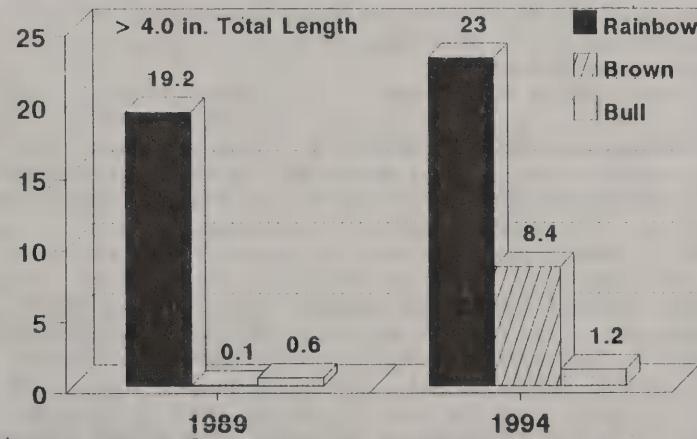


Figure 25. Belmont Creek Fish Population Estimates above Culvert Barrier Before and After Removal, 1990 and 1994.

Juvenile bull trout have been recorded throughout the drainage. YOY presence in past surveys indicates the bulk of bull trout reproduction occurs in reaches above RM 3. In 1988, no bull trout YOY were recorded in samples below stream mile 2.8

In September 1994, a fish population density survey was determined at stream mile 0.6. The sample was located at the site of a 1989 monitoring station, and was taken in order to monitor the effect of the culvert removal on the lower Belmont Creek fishery. The survey found good densities of rainbow trout YOY estimated at 35.2 fish/100 ft (Appendix, Exhibit C). Age 1 plus rainbow trout were estimated at 23.0 fish/100 ft; which represents a increase of 4 fish/100 ft over the 1989 level (Figure 25). The CPUE for rainbow trout in this section is the second highest recorded in the Blackfoot River drainage between 1990 and 1996. In 1989 only two brown trout were captured in the section. Both were adult fish. In 1994, 40 brown trout were captured in the section with densities estimated at 5.6 and 8.4 fish/100 ft for YOY and age 1 plus brown trout, respectively. In 1994, the estimated density of bull trout ≥ 4.0 in. was 1.2 fish/100 ft compared to 0.6 fish/100 ft in 1989.

Two radio-tagged bull trout over-wintered in the Blackfoot River near the confluence with Belmont Creek during 1995 and 1996 (Swanberg 1996). In late spring, radio-tagged bull trout frequently paused in the confluence of Belmont Creek while migrating to upriver locations, but none entered the stream.

One mile of lower Belmont Creek was surveyed for bull trout redds in 1994, 1995 and 1996. We found four redds on September 26, 1994, none in 1995, and four redds in 1996 all above the location of the old culvert.

Fifteen bull trout collected on October 16 and 18, 1991 were analyzed electrophoretically to determine their genetic characteristics. All fish showed only characteristics of pure bull trout (Appendix, Exhibit F).

Cottonwood Creek

Cottonwood Creek, a third-order tributary, flows 16 miles south through a forested valley in upper reaches and moraine and outwash plains in mid- to lower reaches before entering the middle Blackfoot River at river mile 43. Discharge at stream mile 0.9 was 31 cfs on November 1, 1991. The stream was described as "moderately impaired" (MDHES 1994).

Cottonwood Creek originates in a cirque in the Cottonwood Lakes area and flows through a confined, high-gradient, and well-armored channel. Habitat types are plunge pools and scour pools formed by boulders and dense woody debris. As the stream exits its canyon, sinuosity increases and a pool-riffle sequence develops. As the stream enters an outwash plain it loses water; an intermittent section occurs between stream mile 9 and 11, near the mountain-valley interface. The lack of surface water in this section is exacerbated by irrigation withdraws.

Cottonwood Creek gains groundwater beginning at stream mile 9.0, and appears to be a gaining stream to the mouth due largely to three spring creek located between RM 6.3 and 7.5. The channel type shifts to a relatively sinuous pattern. Beaver activity greatly influence channel characteristics through most of the this reach. Over the last 20 years, the influence of beaver on this lower section has significantly increased recently over historic levels when extensive beaver control was practiced. The result has been the creation of a natural beaver wetland complex, probably more near a "natural state" for this stream reach. Few functioning beaver induced wetlands still exist in western Montana, but historically they were relatively abundant. One basin-fed, and at least four small spring creeks, enter this middle reach (Figure 26). Fisheries are impaired in the basin-fed stream, Shanley Creek, and in one of these spring creeks, Spring Creek (see Results Section III and IV). Grazing practices (including ungulates) have damaged stream banks on approximately one mile of stream.

Two major irrigation diversions occur at stream miles 5 and 12. Below the upper diversion, the stream dries in low flow years for 2.5 miles.

Management of the headgate has isolated westslope cutthroat trout and bull trout attempting to escape the dewatered section, resulting in fish kills. Additionally, both diversion structures were barriers to upstream movement of fish and entrained out-migrants. The upper diversion serves an 8,000 foot irrigation canal that irrigates approximately 400 acres of hay on the Blackfoot Clearwater Game Range. This canal was inefficient, carrying only 28% of its

volume to the end-point. At the time this information was recorded, the canal took the entire stream flow (8 cfs) to an irrigation pump with a 1-cfs capacity. Losses of native fish and poor water management provided the impetus for a comprehensive fisheries and water conservation effort.

Whirling disease was detected in a sample of brown and rainbow trout collected below Highway 200 in Cottonwood Creek on November 14, 1995. This was the first positive whirling disease sample from the Blackfoot River drainage. Samples of fish collected in the Blackfoot River one mile downstream of Cottonwood Creek and 2 miles upstream were both negative in 1995 (Appendix, Exhibit K).

Restoration objectives

- 1) Restore connection between upper and lower sections of the creek.
- 2) Initiate water conservation measures.
- 3) Eliminate loss of fish to irrigation canals.

Restoration activities

Restoration projects in Cottonwood Creek began in 1991. Denil fish ladders were fitted to the headgates of both canals. Self-powered, self-cleaning fish screens with 1/8 diameter screen size are currently being installed in the canals immediately below the point of diversion with



Figure 26. Locations of Major Diversions and Fish Sampling Sites in the Cottonwood Creek Drainage.

completion scheduled for spring 1997. Both screening devices are designed so that approach velocities will not exceed 0.4 ft/second at the screen, thereby reducing potential impingement of YOY. Screening devices have by-pass features that allow uninterrupted downstream movement of fish once screened out of the canals.

To improve the efficiency of the canal at the upper diversion, an impervious 12 mil rubber/fiber liner was placed 12 in underground over the entire length. The irrigation system was further upgraded by repairing leaky ancillary ditches and installing small headgate structures to allow better management of flood irrigation. An annual 8,663 acre ft of salvage water, ranging from 6 cfs at base flow to 37 cfs during runoff periods, is also being leased for instream flow during the irrigation season. This project is designed to benefit bull trout and cutthroat trout by improving connectivity between upper and middle stream reaches, improving flows for two miles of dewatered stream, reducing loss of fish to irrigation canals, improving riparian plant communities previously affected by dewatering during the growing season.

Other current projects to improve the fishery in the Cottonwood Creek include implementing rotational grazing systems along one mile of damaged riparian areas, stabilizing 300 ft of braided stream on State Trust Land, and correcting a section of aggraided stream upstream of Woodworth Road that was caused by an undersized culvert.

Fish Populations

Cottonwood Creek supports spawning migrations of rainbow trout, brown trout, cutthroat trout and bull trout. Cottonwood Creek trout populations are distinctly different among three stream sections. In the lower 1 mile of stream, rainbow and brown trout dominate the population (Figure 27). The second section is a brown/brook trout fishery (between mile 1.0 and 11.0). And the third section is a cutthroat/bull trout dominated fishery above stream mile 11.0.

Cutthroat trout and bull trout dominate the fish population upstream of stream mile 11.0. A June 8, 1992 sample at stream mile 12, immediately downstream of the diversion, was composed of 80% cutthroat trout, 18% bull trout, 1.5% brook trout and 0.5% brown trout. The CPUE for bull trout in this sample was 3.2. The CPUE for cutthroat trout was 14.2.

Cottonwood Creek is intermittent between stream miles 9 and 11. Emigrating cutthroat trout have been sampled in this section during runoff periods. From this section to stream mile 1.0, brown trout and brook trout are common, with the density of brown trout increasing in the downstream direction. Low numbers of

cutthroat trout are also present (CPUE 0 to 1.1) (Appendix, Exhibit A). A July 23, 1991 sample at stream mile 7.5 was composed of 60% brook trout, 37% brown trout and 3% cutthroat trout. The fisheries of three spring creeks to Cottonwood Creek are described under the Cottonwood Creek section (Appendix, Exhibit A and C). Only one adult and no juvenile bull trout have been sampled

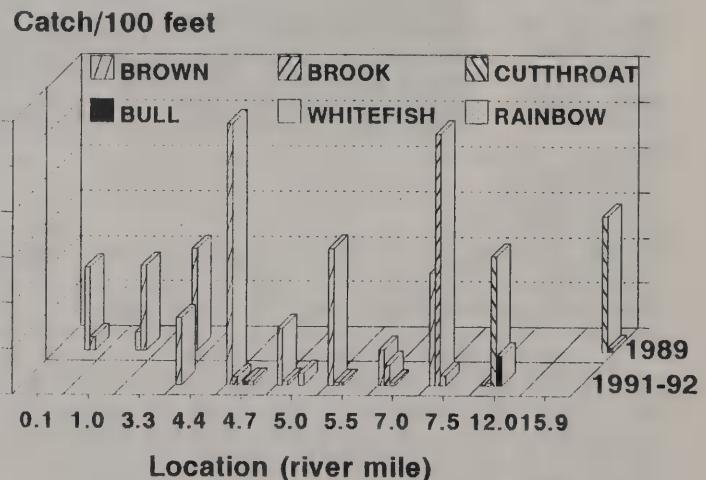


Figure 27. Cottonwood Creek Electrofishing Catch per 100 feet in 10 Sections, 1989 and 1991-92.

recently in the middle reach of Cottonwood Creek. One radio-tagged bull trout paused in the confluence of this stream for less than two days while migrating to Monture Creek, but did not enter it. Adult and juvenile bull trout comprised 2% (1 fish/100 ft) of a 1971 sample at stream mile 3.2 (FWP, unpublished data). Gradient increases downstream of stream mile 1.0. This section of stream supports rainbow trout and brown trout, with very low numbers of cutthroat trout and bull trout (Peters 1990).

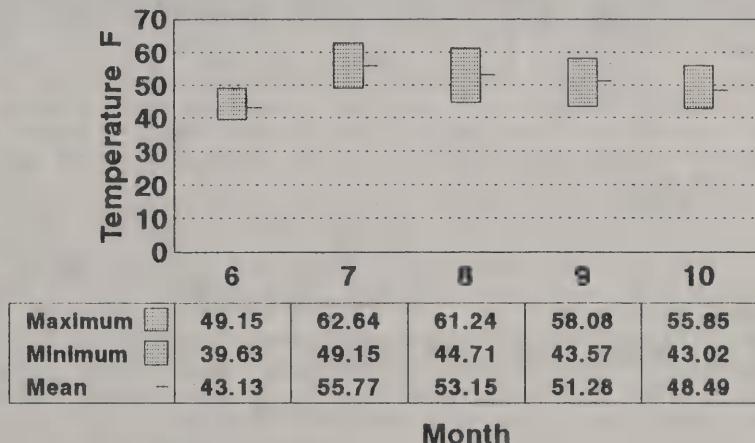
The relatively high density of juvenile bull trout at stream mile 12 may indicate spawning in the area. Redd counts were attempted in 1994 (RM 11.5 to 13.5) and 1996 (RM 11.5 to 15.0). No redds were detected and the exact location of spawning has yet to be determined.

Gold Creek

Gold Creek is a third-order tributary to the lower Blackfoot River. It flows 18 miles south through a glacial valley, entering the Blackfoot River at river mile 13.5. Its base flow measured 24 cfs on September 6, 1989. This stream is the primary tributary to the Blackfoot River downstream of the Clearwater River. The Gold Creek channel is stable, well-armored, and confined. Habitat is mostly rapids and infrequently spaced scour pools. Channel types range from confined bedrock and boulder-dominated sections to relatively unconfined, slightly sinuous, gravel-dominated, laterally-extended sections in some middle and lower sections. Stream gradient is 2% in most lower reaches. Water temperature was monitored in Gold Creek during summer and fall 1996 near the mouth. During this period, maximum temperatures did not exceed 62°F and average temperatures were fairly stable, remaining near 52°F (Figure 28).

Land use in the drainage is primarily commercial timber harvest; most of the drainage is owned by Plum Creek Timber Company. Vast tracts of forest have been harvested since the 1960's. This loss of forest canopy affects interception and evapotranspiration rates, both of which can alter stream flows. Based on the loss of canopy coverage, Schultz (1991), estimated discharge from the Gold Creek drainage has increased approximately 10%.

The harvest of riparian conifers and the removal of large instream wood from the lower channel has also reduced the diversity of stream habitat in lower stream reaches. A 1990 survey showed the lower three miles of stream was dominated by long, low-gradient and boulder riffles averaging 661 ft in length, with one riffle extending 2,400 ft. Pools comprised approximately 3% of the stream area, or 0.13 pools/300 ft, compared to 0.48 and 0.71 pools/300 ft in two sections surveyed upstream (Pierce 1991). The amount of instream wood in the downstream section (0.41 pieces/300 ft) was 12% of that counted in upstream sections (3.3 pieces/300 ft). The low density of age 1 plus fish, including native fish, in the lower 3 miles of Gold Creek, appears result from the simplification of habitat. The over harvest of native



Period of Record 6/96 - 10/96

Figure 28. Summary of Gold Creek Water Temperatures Collected at RM 1.0 in the Summer and Fall of 1996.

fish have also been reported in the drainage, especially in bull trout spawning areas.

Spring Creek and Burnt Bridge Creek are impaired tributaries to lower Gold Creek.

Restoration objectives

- 1) Restore habitat of spawning and rearing trout.
- 2) Facilitate movement fish, especially bull trout and westslope cutthroat trout through lower channel.
- 3) Enhance thermal refuge for native fish from the Blackfoot River.

Restoration activities

A cooperative effort to restore fish habitat began in 1995. Cooperators included Plum Creek Timber Company, the DNRC, the FWS, FWP and the BBCTU. Efforts focused on enhancing step, plunge and lateral scour pools for Rosgen B2, B3 and C3 channel types. We calculated the maximum expected pool frequency of one pool per 200 ft of channel, using a Rosgen formula, where distance between pools equates to 5 to 7 times bankfull stream width (Rosgen 1996). In 1996, approximately 200 large conifer logs (30 to 40 foot stems, 15 to 36 inch diameters), and 40 rootwads were placed in the channel, enhancing or creating 67 habitat units in the lower 3 miles of stream. The percent surface area comprised of pools increased from approximately 3% pre-treatment to 13% post-treatment.

Enhancing overall stream complexity is expected to improve habitat for all life stages of fish using Gold Creek, including native species dependant on high quality habitats. Improved holding water may also provide thermal refuge for bull trout during late summer when river temperatures may be unsuitably warm.

Plum Creek Timber Company has agreed to help address problems with road drainage, illegal stream dredging, and access related recreational impacts to the middle and lower reaches of the drainage. Bull trout spawn in areas influenced by these activities. The DNRC has also expressed a willingness to help correct impacts in the Warm Springs and Burnt Bridge Creek.

Fish Populations

Gold Creek supports spawning migrations of fluvial rainbow, brown trout, bull, and cutthroat trout. A transition zone between fish species occurs between stream miles 5 and 6, with cutthroat trout abundant in the upper reach and rainbow trout and brown trout dominant below this point (Figure 29). Gold Creek is one of three tributaries downstream of the Clearwater River where migrations of fluvial bull trout persist. Good runs of bull trout existed in the 1970's, with anglers regularly catching six to eight pound fish in lower stream reaches. No bull trout of this size have been recorded in recent samples. Bull trout have been recorded from stream mile 11 to the mouth, but the density of juvenile bull trout is highest in the middle reach (Peters 1990).

Fish monitoring stations were established at RM 0.2, 1.9 and 2.5, 2.7 in August 1996 to monitor the response of the fish populations to proposed habitat enhancement work (Figure 30). The two downstream surveys (RM's 0.2 and 1.9) were located in riffle dominated sections. The upstream sample (RM

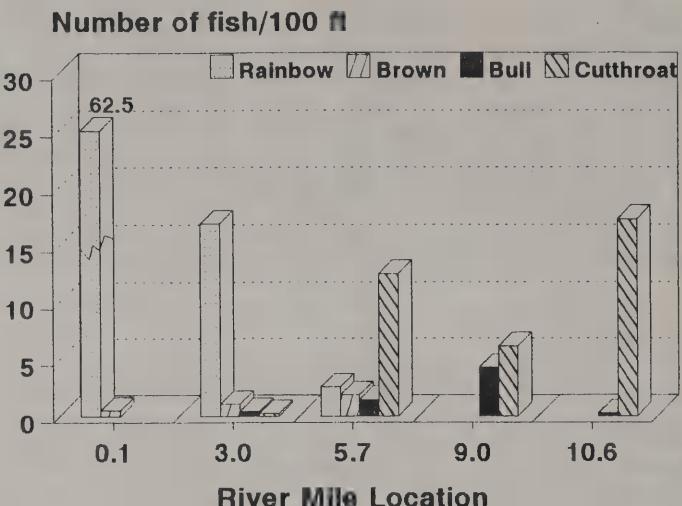


Figure 29. Electrofishing Catch per 100 Feet in 5 Sections of Gold Creek, 1989.

2.5, 2.7) was a reference section for the habitat restoration project; it contained both pool and riffles. CPUE in the reference section (RM 2.5, 2.7) indicated higher densities of all species present than both downstream riffle dominated survey sections (Figure 31).

The RM 0.2 station duplicated a sample taken in spring 1981. The estimated density of all trout ≥ 4.0 in. at this station in 1996 was 20.3 fish/100 ft. Estimated densities of rainbow trout and brown trout

≥ 4.0 in. in 1996 were 9.5 and 7.9 fish/100 ft, respectively (Appendix, Exhibit B). Only 3 of 135 fish captured were ≥ 10 in. Brown trout comprised 61% of the sample, rainbow trout 36%, cutthroat trout 1.5%, and bull trout 1.5%. By comparison, bull trout comprised 11% of the sample in the 1981 survey (CPUE of 1) (FWP, unpublished data).

The fishery in a riffle dominated section, RM 0.2, differed from a section with a mix of pools and riffles, RM 2.5, 2.7, by a lacking larger size classes of rainbow and brown trout and having fewer juvenile bull trout (Figure 32).

A 1996 survey of bull trout redds identified 14 redds in two locations; 10 in the mainstem of and four in the West Fork.

None of the radio-tagged bull trout spawned in Gold Creek, although two fish did enter this stream. One remained in Gold Creek for 10 days in August 1995, ascending the stream 1.5 miles. The second radio-tagged fish using Gold Creek entered the stream after spawning in the North Fork of

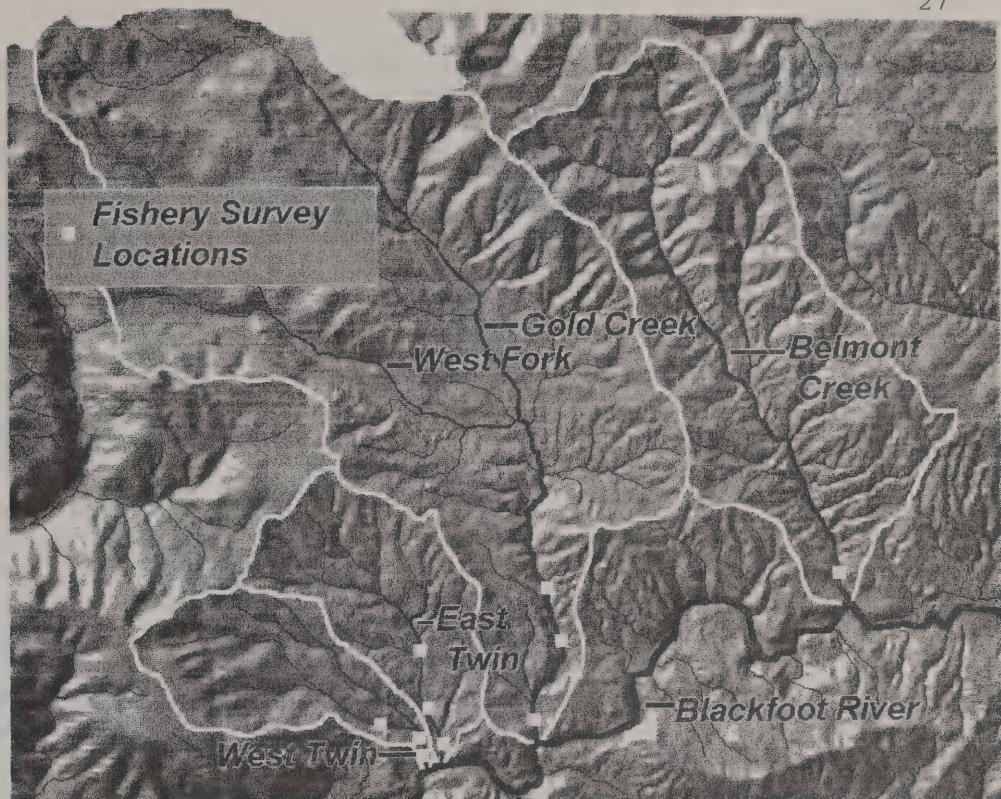


Figure 30. Fishery Survey Location for Gold, Belmont, East and West Twin Creeks, 1990 to 1996.

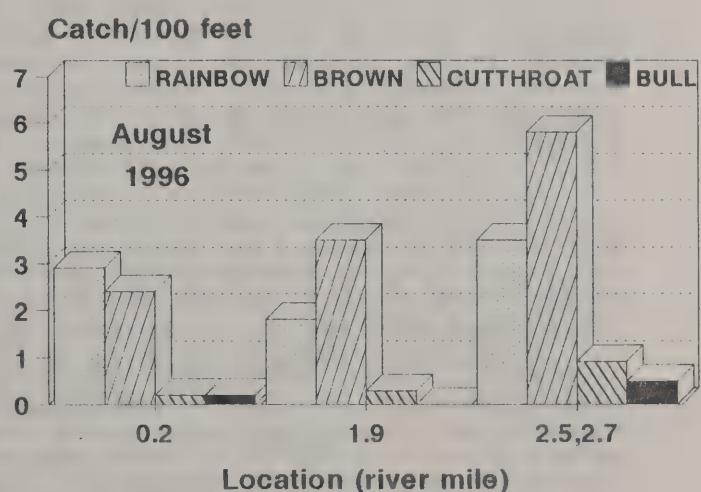


Figure 31. Electrofishing Catch per 100 feet Gold Creek, August 1996.

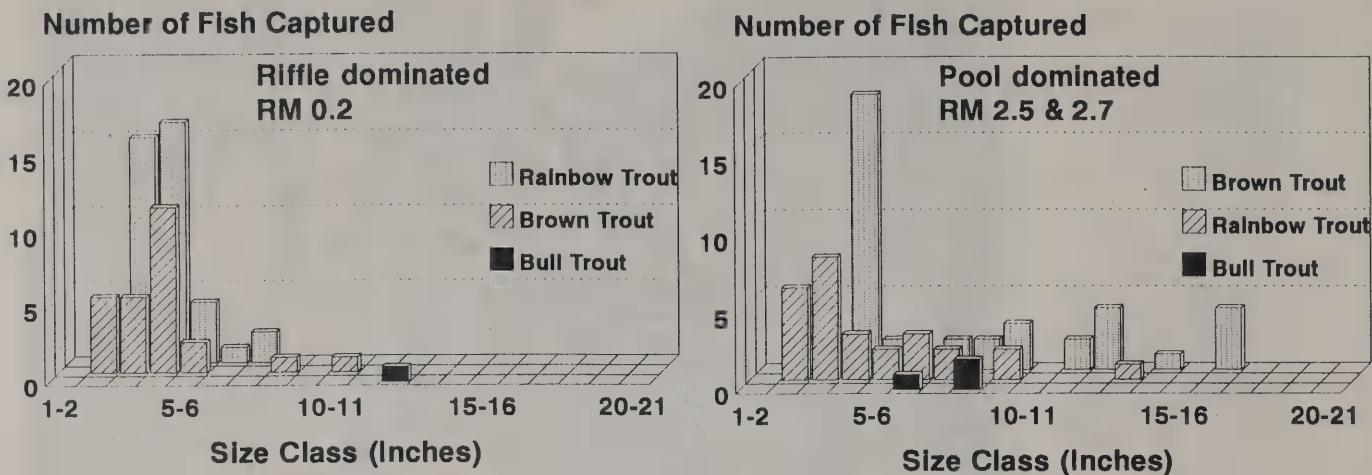


Figure 32. Electrofishing Catch in Riffle (Left) and Pool (Right) Dominated Reaches, August 1996.

the Blackfoot River, 58 miles upstream. This fish ascended 600 ft of the stream into the habitat restoration area newly created during the summer of 1996.

Monture Creek

Monture Creek, a fourth-order tributary to the middle Blackfoot River, originates in a roadless watershed bordering the western and southern flanks of the Bob Marshall Wilderness. It flows 24 miles, entering the Blackfoot River at river mile 44.2. Its base flow measured 44.2 cfs at stream mile 0.4 on August 8, 1989.

After leaving the mountains, the lower reaches of Monture Creek meander in a slightly entrenched channel confined by knob-and-kettle topography. Monture is a laterally moving sand, gravel and cobble bottom stream, characterized by point bars and a pool-riffle sequence in mid- to lower reaches. Rates of lateral movement are largely a function of riparian vegetation for this stream type. Stream sediment levels can be high due to lateral movement and high natural erosion in the upper basin. Streambanks are comprised of fine alluvial material making this channel type particularly susceptible to bank erosion in places. Woody debris and undercut banks are primary habitat features in this system.

Land uses along Monture Creek consist primarily of livestock production.

Much of the riparian area in lower Monture Creek has been cleared, grazed intensively or damaged by livestock feeding; many of the large conifers from the lower riparian area have been harvested. These activities have impacted stream banks and reduced stream complexity in the lower 7 miles of stream (Fitzgerald 1996).

A riparian health inventory of the lower 14 miles of Monture Creek was completed in 1996. Fitzgerald (1996) reported soils, vegetation and stream bank were generally healthy from stream mile 14 to 7.1, although isolated land clearing activities have accelerated lateral erosion in sections between stream miles 11.5 and 10.4. From stream mile 7.1 to the confluence, riparian health has declined with "Unhealthy" and "At Risk" ratings over most of the length of this reach (Fitzgerald 1996).

To assess the percentage of fine sediment (<6.35mm diameter) in bull trout and brown trout spawning areas, McNeil sediment cores (McNeil 1964) were taken next to redds in 1992. Percentage of fine sediments averaged 29.3% with a range of 9.9 to 40.8% in Monture Creek.

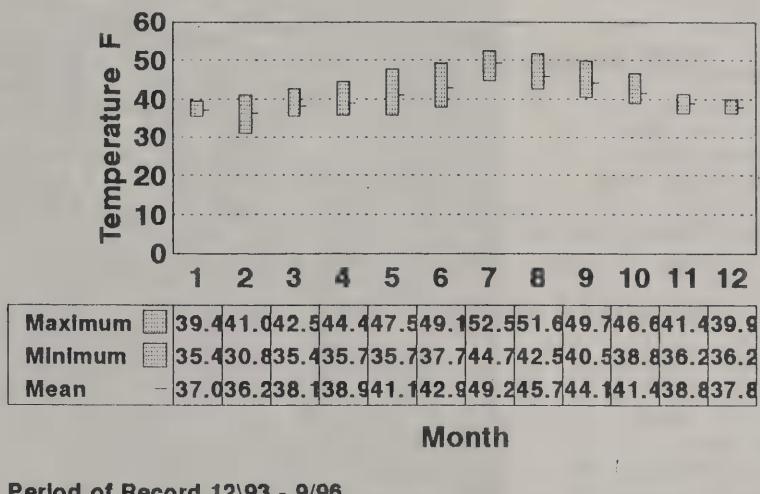
Temperatures have been monitored at two sites in Monture Creek since 1994. Temperatures at the upper site, where bull trout spawn, remained $<52^{\circ}\text{F}$ and had narrow daily and seasonal ranges; winter temperatures remained $>35^{\circ}\text{F}$. Groundwater upwelling greatly influences this temperature regime (Figure 33). Downstream, below the groundwater influence reach, summer water temperatures averaged 3 to 10°F warmer than the upstream site, and had larger daily and seasonal ranges (Figure 34). During winter months, average temperatures in the downstream site were 1 to 2°F cooler than the upstream site; minimum temperatures below 32°F were occasionally recorded.

Restoration objective

- 1) Restore habitat for spawning and rearing bull trout and westslope cutthroat trout.

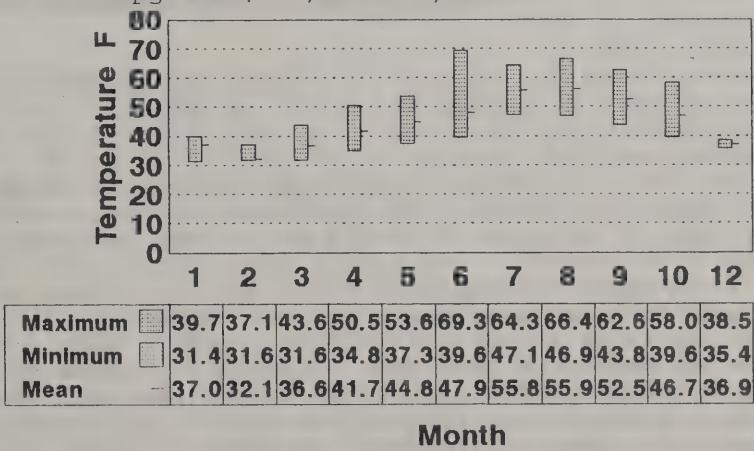
Restoration activities

Restoration efforts began in Monture Creek in 1990. Stream projects have been completed, or are in progress, on two large ranches encompassing 9 miles of stream, or approximately 75% of lower Monture Creek. Livestock were excluded from the immediate stream banks for 6 miles of stream in bull trout spawning and staging areas. Twelve additional projects were completed in the riparian area that reduced impacts to streambanks from livestock grazing. These projects included creating low-impact grazing systems on 2.5 miles of stream, creating off-stream watering sites at three locations, controlling erosion of vertical banks, hardening watering sites for livestock, removing a winter feedlot from the streambank, and planting woody riparian vegetation on two miles of stream. Additionally, restoration efforts have occurred in two tributaries to Monture Creek, Dunham and Dick creeks; these projects



Period of Record 12/93 - 9/96

Figure 33. Monture Creek Water Temperature Summary at the USFS Campground, 12/93 to 9/96.



Period of Record 12/93 - 9/96

Figure 34. Monture Creek Water Temperature Summary at Highway 200, 12/93 to 9/96.

are described in Part III of the results. Further efforts to enhancement habitat in Monture Creek are being considered in the lower to mid-reaches to rebuild habitat functions lost by the removal of large woody debris.

Fish populations

Monture Creek and three lower tributaries to Monture Creek have been surveyed since 1990 (Figure 35). The lower 5 miles of Monture Creek support a fishery dominated by rainbow and brown trout. Upstream, the fishery is predominantly cutthroat trout and bull trout. Fluvial bull trout, cutthroat trout, rainbow trout and brown trout, and resident populations of brook trout, spawn in Monture Creek.

Bull trout use Monture Creek as a migration corridor, pre-spawning holding habitat, for spawning and rearing, and for

thermal refuge. Radio-tagged bull trout entered Monture Creek as early as the first week of June in 1994, although most entered in late June to early July. The majority of these fish did not spawn, but instead held in the lower 10 miles of stream for less than a month before returning to the Blackfoot River in late August. Those bull trout that did spawn migrated directly to previously known spawning areas, and remained there for nearly 2 months before spawning in late September. Most spawners left the stream immediately after spawning, although some fish remained for weeks after redds were complete; one fish remained in this stream through winter before migrating 50 miles to the lower Blackfoot in early spring. After less than 2 months in the Blackfoot River, this fish returned to the spawning area in Monture Creek to repeat spawn. One radio-tagged bull trout spawned in Monture Creek three consecutive years; because it was 28 in when it received its transmitter, it is likely it had also spawned in previous years.

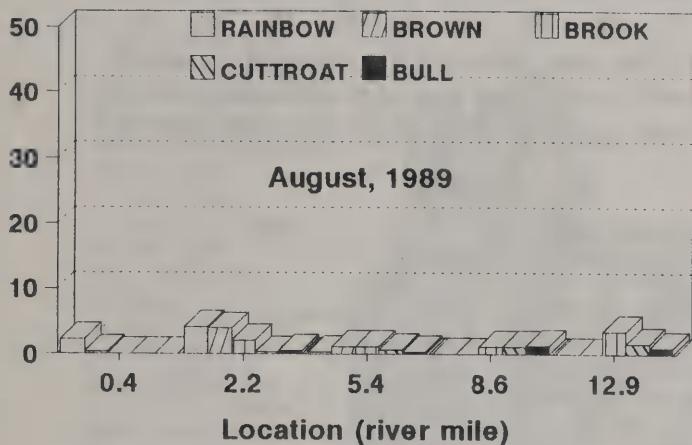
Monture Creek supports the highest number of fluvial bull trout redds in the Blackfoot River drainage. From 1988 to 1996, redd counts in the monitoring section increased from 10 to 65 with a total of 79 redds counted in



Figure 35. Fishery Survey Locations for the Monture Watershed, 1990 to 1996.

a 6.5 mile survey (Appendix, Exhibit J). A CPUE of 6.7 for juvenile bull trout was the highest for this species among all tributaries sampled, and was exceeded only by an irrigation canal in the North Fork of the Blackfoot River (Appendix, Exhibit A). Combining all sampling locations in Monture Creek, CPUE for juvenile bull trout increased from 0.7 to 1.6 from 1989 to 1994. In this same period, CPUE for cutthroat trout increased from 0.9 to 1.6. CPUE also increased for rainbow and brown trout in lower Monture Creek (Figure 36).

Catch/100 feet



Catch/100 feet

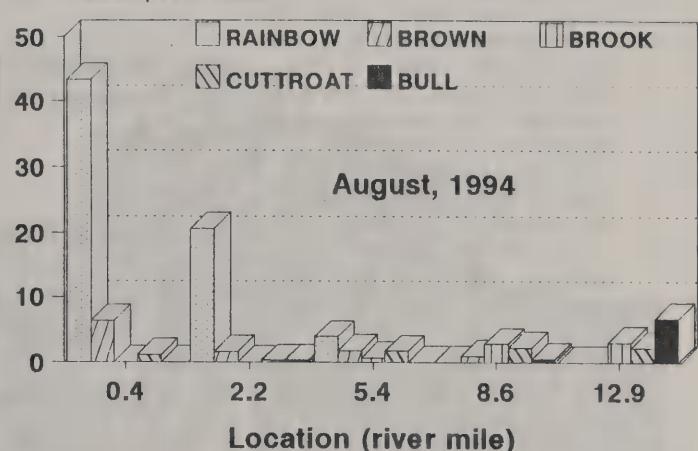


Figure 36. Electrofishing Catch per 100 feet in 5 Sections of Monture Creek during August 1989 (Left) and 1994 (Right).

Redd counts indicate Monture Creek has more spawning bull trout than the North Fork of the Blackfoot River. However, CPUE for all juvenile bull trout in Monture Creek is 55% of that for the North Fork of the Blackfoot River (1.6 vs 2.9). Lower survival of incubating eggs or early life stages may be responsible. This difference in abundance may be related to higher sediment levels, less available rearing space, interspecific competition or poorer quality rearing habitat in downstream reaches of Monture Creek.

North Fork of the Blackfoot River

The North Fork Blackfoot River drains a glaciated watershed in the Scapegoat Wilderness and enters private land at stream mile 16.3. Beginning at the North Fork Falls, the North Fork flows 26 miles south to its confluence with the middle Blackfoot River at river mile 54.1. The cold water temperatures of the North Fork of the Blackfoot River significantly improve the health of the aquatic community in the Blackfoot River below the North Fork confluence (Ingman 1989).

Although the North Fork below the falls has sections of slightly meandering alluvial bottom, it is generally confined to a narrow valley with a bed morphology dominated by highly variable boulder materials, bedrock, rapids and irregularly spaced plunge and scours pools. Most of the channel below the falls is well armored with boulder and cobble, creating a stable channel and small pocket water for juvenile fish. In lower reaches, the stream attenuates to a relatively unconfined, meandering boulder, cobble and gravel bottom with substrate sized generally decreasing in the downstream direction. Woody debris and glacially erratic boulders provide instream cover in the lower reach.

The North Fork of the Blackfoot River has a lower percentage of fine sediment in spawning riffles than Monture Creek. McNeil Core samples taken in 1992 in the wilderness area adjacent to bull trout redds averaged 25.7% fines

(Kramer and Walker 1993).

On Kleinschmidt Flat, an outwash plain, the North Fork Blackfoot River provides rearing areas for young bull trout and a migration route for spawners and juveniles migrating downstream to the Blackfoot River. The loss of fish to five irrigation canals between stream mile 8.8 to 15.0 has been identified. Sampling of juvenile fish in the area of these canals shows a sharp decline in abundance.

Temperatures have been recorded at two sites in the North Fork of the Blackfoot River since 1994. The upper site is located at the USFS bridge below the trailhead, approximately 1 mile below the known lower limit of bull trout spawning. Data from this site probably closely reflect temperatures in the spawning area. Average temperatures at this site remained $<49^{\circ}\text{F}$, and had little daily and seasonal fluctuation (Figure 37). Average monthly temperatures at the lower site, located at the Ovando-Helmville bridge, remained $<54^{\circ}\text{F}$, but were 2 to 6°F warmer than the upper site during summer months (Figure 38).

Restoration objectives

- 1) Eliminate the loss of bull trout to irrigation canals.
- 2) Improve recruitment of native fish to the Blackfoot River.

Restoration activities

Restoration of the North Fork of the Blackfoot River has involved working with irrigators to eliminate fish entrainment into canals. Screens have been installed on two canals and are currently being installed on the three remaining canals. Three types of screening devices are being used. One

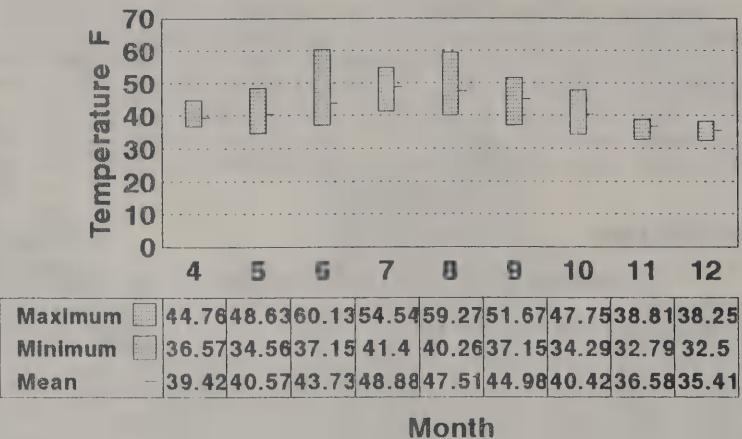


Figure 37. Summary of Water Temperatures at USFS Bridge on North Fork of Blackfoot River, 8/94 to 9/96.

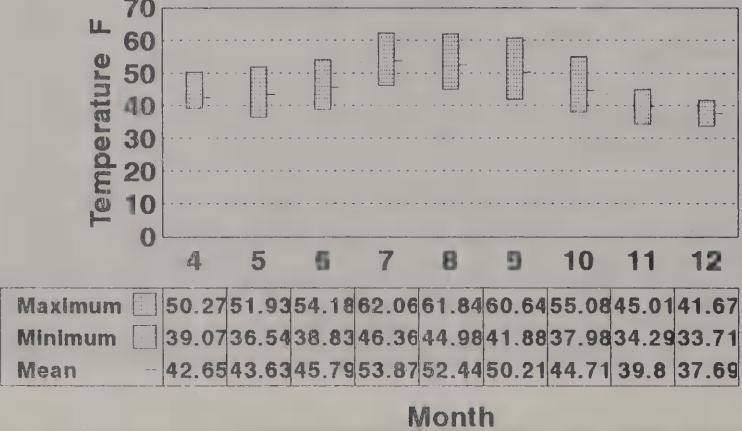


Figure 38. Summary of Water Temperatures at the Ovando-Helmville Bridge on the North Fork of the Blackfoot River, 8/94 to 9/96.

screen is an electrically powered, self-cleaning series of rotating drums designed to pass a maximum of 24 cfs. The second type is an infiltration gallery fitted with back-flush facilities and buried in the river substrate; its maximum capacity is 17 cfs. The third type of screen is a self-cleaning, self-powered paddle wheel design that operates at a range of flows from approximately 4 to 15 cfs. The mesh size on these screens ranges from 1/8 to 3/32 inch, preventing fish of any age class from entering canals. Low approach velocities (< 0.4 ft/second) are engineered into three of the screens to protect YOY from impinging on the screen. All screens also have bypass canals that redirect fish to the river.

Improvements to the management of livestock along eight miles of riparian corridor have also been accomplished. Other projects that have been completed in this drainage include the development of offstream watering sites and water conservation measures.

Fish Populations
The North Fork Blackfoot River supports bull trout, cutthroat trout, rainbow trout and brown trout, with the relative abundance of native species increasing



Figure 39. Fishery Survey Locations in the North Fork Blackfoot River Watershed, 1990 to 1996.

upstream of stream mile 4 (Peters 1990). The North Fork of the Blackfoot River is prime fluvial bull trout and westslope cutthroat trout habitat. Electrophoretic analysis of 20 bull trout collected on October 1995 from the North Fork revealed no hybridization with brook trout (Appendix, Exhibit F).

Three levels of fish sampling have been undertaken on the North Fork Blackfoot River: 1) bull trout redd counts, 2) duplication of 1989 juvenile shoreline samples, and 3) population surveys in the lower reach of the North Fork. Fishery surveys have also been completed in all irrigation canals (Figure 39).

From 1989 and 1996, redd counts for bull trout in the North Fork increased from 7 to 59. The use of the North Fork of the Blackfoot River by radio-tagged bull trout was similar to that observed in Monture Creek. Most radio-tagged fish entering this stream did not spawn, but instead held in the lower portions of the stream for less than a month before returning to the Blackfoot River.

Bull trout spawned in the North Fork of the Blackfoot River from RM 20 to 26. Spawning activity is generally dispersed within this section with a couple of concentrated usage areas. Bull trout use the pool tailouts formed behind boulders in the confined B2-B3 channel reaches as well as tailouts on larger channel scour pools in the C3 channel reaches of the North Fork. The largest concentration of spawning occurs in the C3 channel reaches. The substrates in the North Fork are dominated by larger cobble and boulders with limited availability of spawning sized gravels.

Total CPUE for juvenile bull trout in shoreline samples increased from 1.7 to 2.9 from 1989 to 1994. In 1994, bull trout CPUE ranged from 13.0 at mile stream 17.2 to 0.6 at stream mile 2.6, but declined steeply between stream miles 17.7 and 11.5 (Figure 40). This decline was probably related to entrainment of fish to irrigation canals.

Five irrigation canals (stream miles 15.3, 12.3, 10.7, 10.0 and 8.8) have been sampled since 1994. The highest CPUE of juvenile bull trout, 26.1, among all sample locations in Blackfoot River drainage occurred in the upstream canal in August 1994. Bull trout were also entrained in downstream canals, but to a lesser extent. For example, CPUE in the next canal downstream was 0.8 in July 1994. The upstream canal was screened in 1995; sampling in the ditch below the screen in 1996 found no

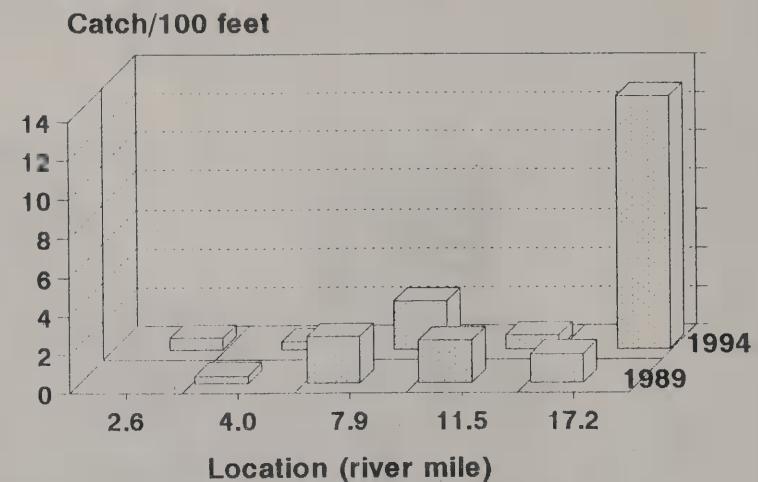


Figure 40. Electrofishing Catch per 100 feet for Juvenile Bull trout (≤ 12.0 in. TL) at 5 Locations in the North Fork, 1989 and 1994.

Number/1000 feet

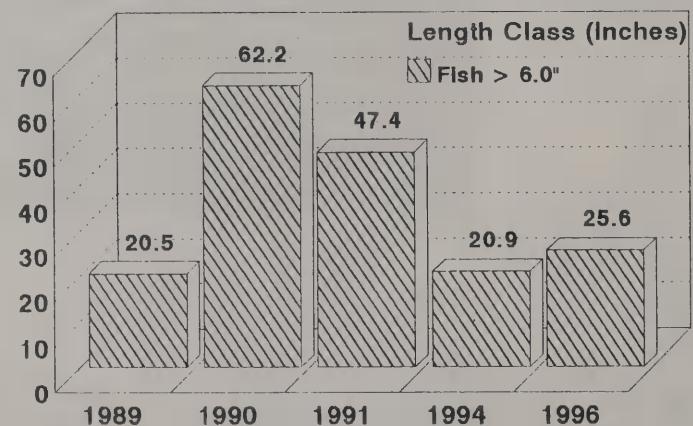


Figure 41. Combined Densities of All Trout ≥ 6.0 in TL in the Harry Morgan Section of the North Fork of the Blackfoot River, 1989 to 1996.

fish. However, after the upstream canal was screened, the CPUE in the next canal downstream rose to 13.7 in August 1996, indicating the entrainment problem had been displaced downstream (Appendix, Exhibit A).

A long-term fish population monitoring section was established in 1989 from river mile 6.1 to 2.3, starting at the Highway 200 bridge and ending at the Harry Morgan FAS. The section was named the Harry Morgan section. This section has been surveyed five times 1989, 1990, 1991, 1994 and 1996. In 1996, the composition of the North Fork fishery in the Harry Morgan section was 55.3% brown trout, 21.7% rainbow trout, 12.8% bull trout and 10.2% cutthroat trout.

In 1989, density of all trout ≥ 6.0 in the Harry Morgan section was 20.5 fish/1000 ft (Peters 1990). In 1990, this density increased to 62.2 fish/1000 ft, reflecting increased numbers of 6.0 to 11.9 inch rainbow trout and brown trout (Figure 41). From 1990 to 1996, total densities of trout have declined to 25.6 fish/1000 ft. Densities of cutthroat trout ≥ 8.0 in. TL and bull trout > 6.0 in. TL have been relatively stable between 1989 and 1996 (Figure 42). While brown and rainbow trout ≥ 6.0 in. TL estimated densities have varied considerably, with respectively 328% and 600% maximum variation between 1989 and 1996. Cutthroat ≥ 8.0 in. TL density estimates ranged from 0.8 fish/1000 ft

in 1989 to 1.7 fish/1000 ft in 1996. Density estimates for bull trout ≥ 6.0 in. TL ranged from 1.7 to 4.4 fish/1000 ft from 1989 to 1996. Densities of bull trout ≥ 12.0 in appear to be on an increasing trend, increasing from 0.8 in 1989 to 1.6 fish/1000 ft in 1996 (Figure 43).

Landers Fork and Copper Creek

Copper Creek joins the Landers Fork at river mile 3 with an average summer discharge of 20 cfs. Sections of the riparian zone in the Copper Creek drainage burned in 1976. Many trees were also

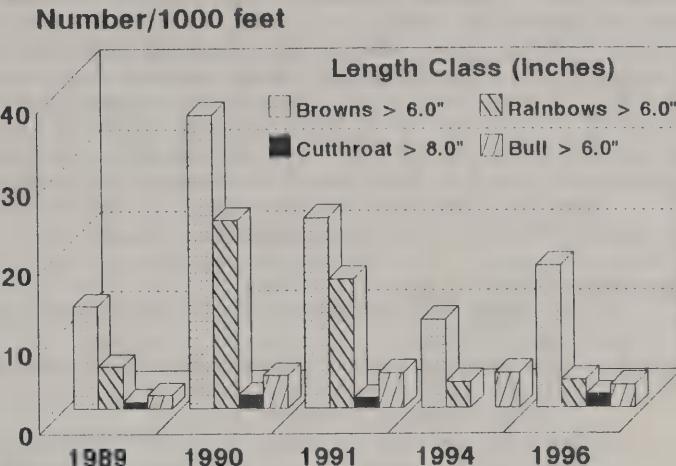


Figure 42. Estimated Densities of Brown, Rainbow, Cutthroat and Bull Trout ≥ 6.0 in. TL in the Harry Morgan Section of the North Fork, 1989 to 1996.

Figure 42. Estimated Densities of Brown, Rainbow, Cutthroat and Bull Trout ≥ 6.0 in. TL in the Harry Morgan Section of the North Fork, 1989 to 1996.

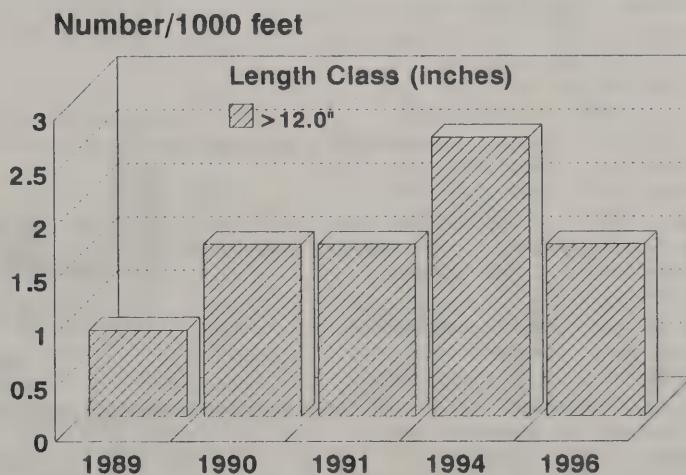


Figure 43. Estimated Densities of Bull Trout ≥ 12.0 in. TL in the Harry Morgan Section of the North Fork of the Blackfoot River, 1989 to 1996.

affected by winterkill in 1989. As a partial result of these two events, woody debris is abundant in the channel. Water temperatures were recorded in the bull trout spawning area of Copper Creek during the summer and fall of 1996. Summer maximum temperature averaged 46°F; little daily and seasonal fluctuation occurred. This temperature regime is similar to that observed in spawning areas of Monture Creek an the North Fork of the Blackfoot River.

The movement and habitat use of bull trout in the Blackfoot River/Landers Fork/Copper Creek system are not well known. FWP, Helena National Forest, and the BLM cooperatively conducted a telemetry project with five bull trout in this area during summer 1996. Radio-tagged bull trout have been tracked migrating from the Blackfoot River to Copper Creek, documenting the existence of a fluvial life-history form in this area (Swanberg and Burns 1997). Two of the radio-tagged bull trout spawned in an previously unknown area upstream of the index reach.

Restoration objectives

- 1) Enhance and protect the fluvial bull trout spawning populations using the system.
- 2) Develop better information on the movement and habitat utilization of bull trout and cutthroat trout in the Blackfoot River/Landers Fork/Copper Creek system.
- 3) Determine the feasibility of habitat restoration of the Landers Fork stream channel.

Restoration activities

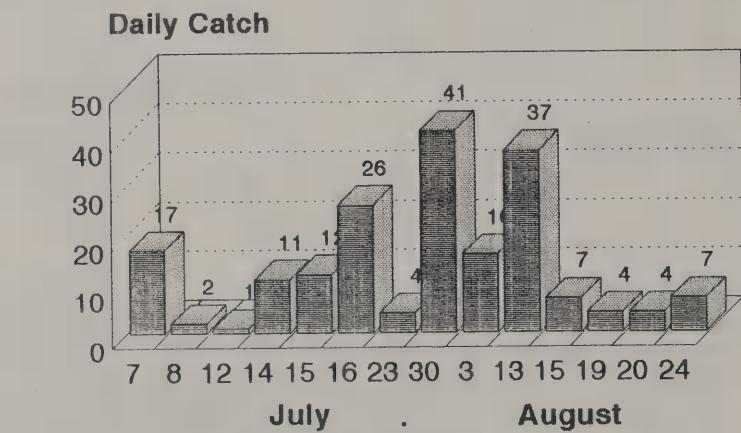
The fluvial bull trout radio-tracked in Copper Creek appear to complete their life histories in less than 20 miles of river system (Swanberg and Burns 1997): spawning occurs in Copper Creek and over-wintering occurs in the Blackfoot River immediately downstream and upstream of the Landers Fork confluence and in the Landers Fork. This contrasts with bull trout in the lower Blackfoot River, which may use greater than 80 miles of river in a year (Swanberg 1996). However, the low sample size and collection timing may easily have missed the full extent of movement activity in the upper Blackfoot.

Fish Populations

Both Copper Creek and the Landers Fork support predominately native fish species assemblages including: bull trout, westslope cutthroat trout, mountain whitefish, and sculpin. Occasional non-native fish, brook and brown trout, have been collected in the lower Landers Fork.

Electrophoretic analysis of 25 bull trout collected in Copper Creek on October 1995 revealed no hybridization with brook trout (Appendix, Exhibit F). Evidence of genetic variation could not be found between the Copper Creek and the

North Fork of the Blackfoot River bull trout however these results were considered inconclusive because of the weakness of tests for detection of genetic variation (Leary 1996).



from Joyce Young's father's fishing diary

Figure 44. Angler's Daily Catch Record from a 1911 Fishing Diary of the Landers Fork.

Historically, the Landers Fork appears to have produced fine fishing opportunity for native fish. An anglers summer fishing log from 1911 covering 14 days of fishing in the Landers Fork averaged 13.5 fish/day (Figure 44).

Bull trout redds have been counted annually in an indexed reach of Copper Creek since 1984 by the USFS. The number of redds during this time has been stable, averaging 20.4 per year. In 1996, radio-tagged bull trout spawned in an area upstream of the index reach. Fourteen redds were counted in this newly identified spawning area, comprising 40% of the total number counted in the Landers Fork - Copper Creek drainage.

A significant amount of new fish and aquatic habitat information was collected in the upper Blackfoot River basin during the summer of 1996 by BioAnalysts, Boise, ID under contract with the Seven-Up Pete Joint Venture (Hillman and Chapman 1996). This effort focused on the geomorphic and physical habitat conditions of the streams adjacent to the project. Fish sampling was stratified among habitat groupings identified by the geomorphic classifications. Hillman located 2 bull trout redds in the upper Blackfoot River downstream of the town of Lincoln in 1996. Their data identified physical habitat conditions in the Landers Fork and sections of the Blackfoot and Copper Creek that contributed to low densities of the native fish species.

RESULTS: PART III

RESTORATION OF OTHER CRITICAL COLD-WATER TRIBUTARIES

Basin Spring Creek

Basin Spring Creek is a small spring creek to lower Chamberlain Creek. It forms at the base of a high river terrace and flows west 0.7 miles through sedge and willow wetlands along the base of a lower river terrace. It joins Chamberlain Creek immediately upstream of the confluence of Chamberlain Creek and the Blackfoot River. Spring discharge is approximately 2 to 4 cfs.

Historically, the combined flow of Basin and Pearson creeks occupied the same channel. While Pearson Creek was diverted for several decades, Basin Spring Creek occupied the channel, flowing through a drained wetland and heavily impacted stream channel. Under previous land ownership, Basin Spring Creek was the water source for a livestock wintering area. Wet, unstable banks, runoff from a feedlot, and heavy livestock use caused extreme degradation in the upper area of the spring creek.

Restoration objectives

- 1) restore wetlands and stream habitat.
- 2) restore migration corridor to lower Pearson Creek.

Restoration Activities

To restore Basin Spring Creek, stream habitat was enhanced, an instream wetland was restored, and changes to land management were made. The project involved restoring a 9-acre wetland and constructing a 200 ft channel connecting this wetland to one downstream, allowing the seasonal movement of fish. From the source area to the wetland, the stream was narrowed to the geometry of an E5 channel type. Gravel was placed in the channel at the upper end of the spring where the gradient existed to create spawning areas. Woody debris was added to pools and native shrubs were planted along damaged banks. Changes to riparian management included removing wintering livestock from the riparian area and initiating a low impact grazing system with deferred grazing in source area. The final element of restoration was the reconnection of Pearson Creek to its historical channel (See Pearson Creek).

Fish populations

Brook trout dominated a fish sample taken prior to restoration with a CPUE of 16.7; longnose suckers (8.5) and one rainbow trout (0.4) were present in the sample (Appendix, Exhibit A). After the project was completed, 90 pure

strain westslope cutthroat trout were collected from the adjacent drainage in the Garnet Range and added to the system. In spring 1996, two cutthroat trout redds were observed in the source area. Beaver have also colonized the wetland since project completion. The presence of beaver may benefit the cutthroat trout fishery by plugging the channel between wetlands except during high flow periods, thereby allowing the selective passage of cutthroat trout. Cutthroat recruits from Pearson Creek have been documented moving into Basin Creek and its wetland area. Hook-and-line surveys in 1996 showed good numbers of cutthroat trout in the spring creek/wetland system.

Bear Creek

Bear Creek, a second-order tributary to the lower Blackfoot River, flows 6 miles north through commercial forest before joining the Blackfoot River at river mile 12.2. It has an estimated base flow of 3 to 5 cfs. Upper Bear Creek is confined by steep mountain slopes in a narrow canyon that widens in the lower two miles. Habitat is generally formed by high energy plunge and scour pools, but attenuates to a pool-riffle sequence in the lower reach. Woody debris is the principle component to the habitat, although it is lacking in mid- to lower reaches.

Stream habitat was surveyed in 1995 (Plum Creek Timber Company, unpublished data). This survey identified problems with upstream fish passage and losses of fish to an irrigation canal in the lower 1.5 miles. The stream was also lacking pools as a result of past channelization, logging and grazing in riparian areas. Artificial redirection of 0.8 miles of channel with heavy equipment to increase production of livestock forage in the valley bottom further degraded the stream habitat. This alteration forced a significant segment of the lower stream to the west side of the valley and created a linear, uniform channel with low habitat complexity. The former floodplain has since reverted to a knapweed dominated meadow.

Restoration objectives

- 1) Restore stream habitat degraded by historical activities in the channel.
- 2) Eliminate barriers to upstream migration.
- 3) Eliminate loss of fish to irrigation canals.

Restoration activities

A cooperative effort to restore fish populations in Bear Creek began in 1995 (Appendix, Exhibit E). Approximately 100 large conifers were placed in the lower two miles of channel, creating pools suitable for larger fish. The project included habitat enhancement in the channelized section; however a 25-year flow event caused approximately 50% of the structures in the channelized section to fail six months after placement due, in part, to the constriction of flood waters in the channelized section. Reconstruction of the channel to its natural geometry (C4) is currently being considered. The undersized culverts were replaced with baffled culverts and placed at grade in 1996, allowing fish to move upstream of stream mile 1.8. The efficiency of the irrigation canal was improved; and its headgate screened in 1997.

Measures to improve management of riparian grazing are being implemented in middle reaches. This project includes cross fencing, implementing rotational grazing practices, and planting native shrubs along damaged stream banks.

Fish Populations

Bear Creek supports an impaired, mixed fishery. Bull trout were absent from recent samples, although present historically (FWP, unpublished data); and YOY bull trout was captured at the mouth in 1996. Fish population surveys, made at three locations (RM 1.1, 1.5 and 1.8), show low densities of juvenile fish and very low densities of adult fish (Appendix, Exhibit A). Densities of rainbow trout ranged from 4.6 to 6.5 fish/100 ft. Brown trout densities at stream mile 1.1 were estimated at 2.4 fish/100 ft and densities

of brook trout from 1.8 and 12.0 fish/100 ft (Appendix, Exhibit B). The cutthroat trout fishery in Bear Creek appears to be in especially poor shape, with only two cutthroat trout recorded in the four sampling locations.

Blanchard Creek

Blanchard Creek, a second-order stream, flows 13 miles south and east through a glacial landscape of low-rolling, morainal foothills joining the Clearwater River at RM 2.9 with base flows ranging from 2 to 4 cfs. Commercial timber harvest, livestock grazing, and irrigation are the dominant land-use activities in the lower drainage.

Blanchard Creek was historically dewatered in its lower one mile from irrigation withdraw. Fish populations surveys in 1990 indicated this dewatering, and associated poor fish passage at headgates for two irrigation canals, negatively impacted the fishery. Other problems identified in the drainage were road erosion and livestock impacts to the riparian area.

Restoration objectives

- 1) Develop water leases with landowner to obtain minimum instream flows.
- 2) Improve access, spawning, and rearing conditions for trout.
- 3) Improve recruitment of trout to the Blackfoot River.

Restoration activities

Using the Wetted Perimeter method (Nelson 1989), the minimum amount of instream flow needed to maintain suitable trout habitat at stream mile 0.1 was calculated at 3 to 5 cfs. In 1991, a water lease was negotiated with a private land-owner maintaining minimum flows of 3 cfs throughout the irrigation season.

Several fishery improvements have also begun in the drainage. At both diversion points, "fish-friendly" structures were fitted with fish ladders. A landowner is currently removing a calving facility and spring livestock concentration from the streambank of lower Blanchard Creek. Improved management of riparian grazing was initiated by Plum Creek Timber Company and the DNRC. Low impact grazing systems are being considered in lower reaches. A culvert under Highway 200 was also modified in 1992 by the DOT to facilitate passage of fish.

Fish Populations

Blanchard Creek has both rainbow trout and cutthroat trout dominated stream reaches and is a good producer of both species. The transition between the two fisheries occurs between stream mile two and three. Blanchard Creek also supports low densities of brown trout and brook trout, as well as several native non-salmonids in the lower reaches (Appendix, Exhibit A). According to local accounts, Blanchard Creek supported bull trout as recently as the 1970's, but none have been reported in recent years.

Fish populations in lower Blanchard Creek (RM 0.1), in the area of the water lease, were monitored from 1990 to 1995 (Figure 45). During this period, densities and species richness improved. Total estimated densities of rainbow trout increased from 20 fish/100 ft to 52.7 (Appendix, Exhibit C). Of these numbers, rainbow trout YOY showed the highest increases from 14.4 to 40.8 fish/100 ft. Age I+ rainbow trout densities roughly doubled, from 5.6 to 11.9 fish/100 ft (Figure 46). Brown trout CPUE increased from 0.6 to 2.6. Estimated brown trout densities were 4.8 fish/100 ft in September 1995. Species richness improved from three species present in 1990 to eight species present in 1995 (Appendix, Exhibit A).

In August 1990, cutthroat trout at stream mile 3.3 had the third highest CPUE (27.4) and the highest YOY CPUE (18.7) of any stream sampled in the Blackfoot River drainage since 1990. This stream also had the highest rainbow trout CPUE in the Blackfoot River drainage at stream mile 1.1; however, this number was influenced by an irrigation diversion which seemed to concentrate fish. Additional improvements to riparian management, including habitat enhancement and low-impact riparian grazing systems, are currently being



Figure 45. Fishery Survey Locations in the Blanchard and Elk Creek Watersheds, 1990 to 1996.

considered.

Chamberlain Creek

Chamberlain Creek flows north for approximately 10 miles before joining the Blackfoot River at RM 44 with a base flow of 2 to 4 cfs. This stream generally flows through a confined valley, with a slightly sinuous channel and a series of small riffles flowing over cobble substrates and dense instream woody debris. The channel is generally stable in upper reaches. Downstream of stream mile 4, sections of Chamberlain Creek have been severely altered. Beaver wetlands occur at its mouth.

Chamberlain Creek had an excellent population of westslope cutthroat trout at stream mile 3.9; however, immediately below this location barriers to fish migration, and poor habitat and stream flow problems severely limited its contribution to the Blackfoot River.

A survey of fish habitat was completed on Chamberlain Creek in 1990. The habitat survey reported a deteriorated condition in habitat quality with 56% of the reaches reported to be impaired (Pierce 1991). Impacts to the stream included lack of woody debris, poor fish passage near the mouth, dewatering from irrigation withdraw, livestock impacts, and channel alterations from road building (Pierce 1991). Additionally, 300 ft of channel had been scarified by heavy machinery near the mouth for a pond development in the stream channel. Road drainage problems in the East and West Forks of Chamberlain Creek contributed excessive sediment to the mainstem.

Restoration objective

- 1) Restore stream channel to allow fish access from the Blackfoot River.
- 2) Improve recruitment of juvenile westslope cutthroat to the Blackfoot River.
- 3) Maintain fish passage and connectivity of Chamberlain Creek to the Blackfoot River.

Restoration activities

Restoration projects began in the Chamberlain Creek drainage in 1991. Through cooperative efforts, private land owners near the mouth converted from flood irrigation to more efficient sprinkler irrigation and consolidated irrigation canals in 1993. These actions helped conserve water and allowed the removal of one fish passage barrier. Habitat for one mile of stream (stream mile 0.5 to 1.5) was enhanced by placing large woody debris in the channel. The proposed instream pond development was moved to an off-stream location and free fish passage maintained.

In 1996, the Heart-Bar-Heart Ranch donated a 3,089 acre-ft water lease for instream flow. This lease will allow 50% of the total discharge for Chamberlain Creek during the irrigation season for instream flow purposes. Basin Creek a small spring creek tributary was restored. Pearson Creek, the largest tributary to Chamberlain Creek, was reconnected to its historical channel in 1994, in turn reconnecting Pearson Creek to lower Chamberlain Creek. This action further increased flows in Chamberlain Creek from 1 cfs at base flow to 8 cfs at high flow periods (see Pearson Creek).

Plum Creek Timber Company deferred grazing in riparian corridors along the mainstem and West Fork of Chamberlain Creek, and took measures to control road erosion in the East Fork and West Fork of Chamberlain Creek. Final restoration activities, which are scheduled for the 1997 field season, include additional measures to conserve water, improving riparian grazing practices, limited habitat enhancement work, and eliminating the last human-created fish passage barrier at stream mile 0.7.

Fish Populations

Chamberlain Creek supports a cutthroat trout dominated fishery from headwaters to its confluence with the Blackfoot River. Angler tag returns of

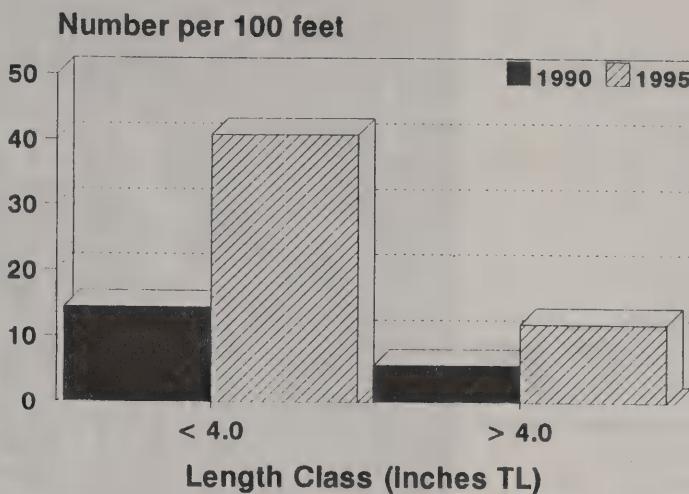


Figure 46. Estimated Densities of Rainbow Trout in Blanchard Creek, 1990 and 1995.

East and West Forks of Chamberlain Creek contributed excessive sediment to the mainstem.

Blackfoot River cutthroat recaptured in Chamberlain Creek and movement of radio tagged cutthroat into Chamberlain Creek both indicate a fluvial component to the fishery (FWP, unpublished data). Chamberlain Creek also supports low numbers of brown trout, rainbow trout and brook trout. Bull trout were recorded in Chamberlain Creek as recently as the early 1980's (BLM, unpublished data), but none have recorded in recent sampling.

In 1989, Chamberlain Creek had the highest densities of trout of 20 tributaries sampled. However, CPUE for cutthroat trout declined in downstream direction from 70.1 (mile 3.8) to 0.5 at stream mile 0.1 due to severe stream impacts such as channel alterations, poor fish passage and dewatering.

Following the completion of phase I of the Chamberlain Creek restoration effort in 1995, two monitoring stations at stream mile 0.1 and 0.5, which were established in 1989, were resurveyed (Figure 47). At stream mile 0.1, CPUE for cutthroat trout (>4.0 in. TL) increased from 0.5 to 10.3 (Figure 48), but remained unchanged at stream mile 0.5. In 1995, both sections held similar densities of approximately 30 fish/100 ft indicating populations levels had stabilized. Approximately 60% of the cutthroat trout in both sections were age 1 plus. CPUE for brown trout (≥ 4.0 in. TL) increased from 2.0 to 2.5 at stream mile 0.1 between 1989 and 1995 (Figure 48). CPUE for both cutthroat and brown trout YOY showed a sharp increase between 1989 and 1995 (Appendix, A).

Dick Creek

Dick Creek, a second-order stream, flows 7 miles in a southwesterly direction, discharging an estimated base flow of 8 to 12 cfs into Monture Creek at stream mile 4.0 (Figure 49). This stream flows through low-relief moraines and flat sedge meadows. It is basin-fed in upper reaches, but goes intermittent in middle reaches from loss of water to alluvium and irrigation. In lower reaches, Dick Creek is spring fed and perennial.

Fish populations in Dick Creek were impaired by dewatering, obstructions to passage, channel dredging and losses to irrigation canals. Riparian

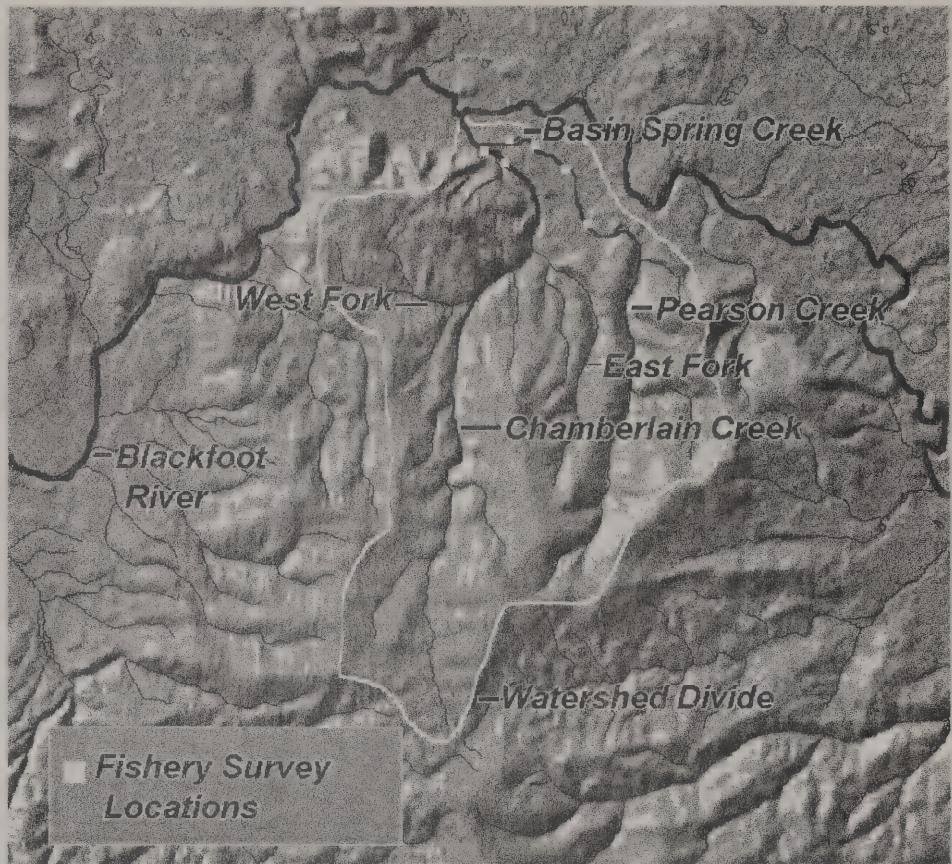


Figure 47. Fishery Survey Locations in the Chamberlain Creek Watershed, 1990 to 1996.

grazing and a streamside feedlot also affected habitat. A 1-mile section of stream had been dredged and mechanically widened to 20 ft; scars indicated the width of the original channel averaged five ft. This section was a poor rearing environment, extremely shallow and wide, and a formidable path for migrating bull trout and westslope cutthroat trout. Irrigation and grazing practices have further altered habitat, restricting passage of fish into tributaries of Dick Creek.

Restoration objectives

- 1) Restore channel morphology to improve fish habitat and stream access.
- 2) Improve livestock grazing practices along stream corridor and uplands.
- 3) Reestablish wetlands.

Restoration Activities

Restoration of Dick Creek began in 1993 with reconstruction of the dredged channel using three methods including construction of a new channel, diversion into old meanders and narrowing of some dredged sections. The restored E6 channel was constructed to conform with historic channel dimensions taken from reference reaches. Restoration of the Dick Creek channel resulted in an increase of 6,050 ft of channel length. Further improvements to fish habitat included the reestablishment of the channel configuration to fit an E6 channel type, adding woody debris, and creating overhanging banks. Riparian vegetation was also transplanted from adjacent sites. Additional projects completed in the drainage included: constructing water control structures that created wetlands benefitting waterfowl (some of which were designed to filter livestock run-off); removing a feedlot from the streambank, removing two fish barriers at irrigation diversions, hardening stream crossing used by livestock, removing a failing stream crossing structure made of logs and earth; and eliminating livestock from wetlands and riparian areas by fencing and creating off-stream watering.

Fish Populations

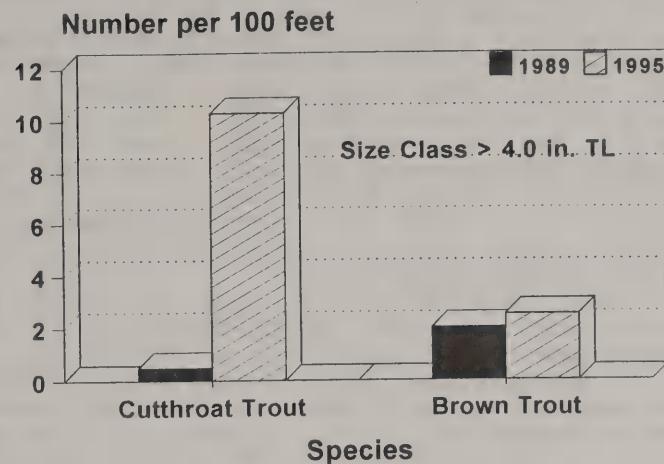


Figure 48. Electrofishing Catch (>4.0 in TL) per 100 feet at mile 0.1 on Chamberlain Creek, 1989 and 1995.

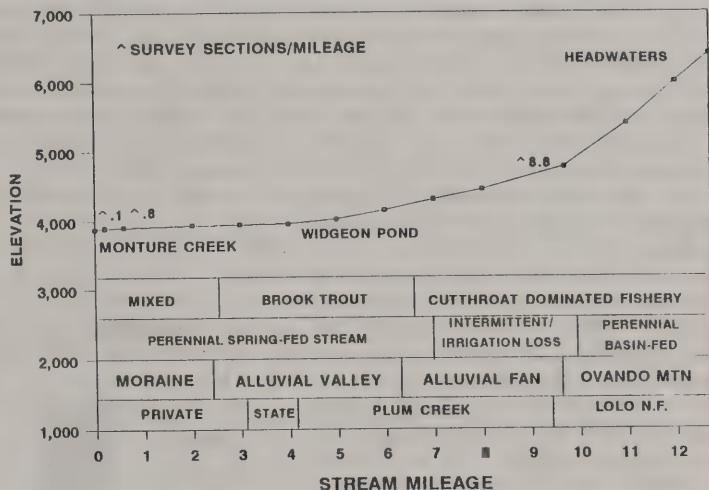


Figure 49. Dick Creek Longitudinal Profile

of natural clay bottoms, deepening and narrowing the channel configuration to fit an E6 channel type, adding woody debris, and creating overhanging banks. Riparian vegetation was also transplanted from adjacent sites. Additional projects completed in the drainage included: constructing water control structures that created wetlands benefitting waterfowl (some of which were designed to filter livestock run-off); removing a feedlot from the streambank, removing two fish barriers at irrigation diversions, hardening stream crossing used by livestock, removing a failing stream crossing structure made of logs and earth; and eliminating livestock from wetlands and riparian areas by fencing and creating off-stream watering.

The upper portion of Dick Creek is dominated by cutthroat trout. A fishery survey at stream mile 8.8 completed in the spring 1992 recorded a CPUE of 20 cutthroat trout, with lower numbers of brook trout (CPUE of 9.0) (Appendix, Exhibit A). A mixed fishery, dominated by brook trout and brown trout, exists in the lower, spring-fed portion of Dick Creek. Two samples taken prior to restoration efforts near the confluence of Dick and Monture creeks in May 1992 revealed greater species diversity, although densities were generally low and most fish were juveniles. The sample included rainbow trout (CPUE 1.9-2.1), brown trout (CPUE 0.8-1.7), brook trout (CPUE 1.2) and cutthroat trout (CPUE 0.2). Other species present were mountain whitefish, longnose sucker, longnose dace and sculpin. Bull trout were historically present in lower Dick Creek.

Dunham Creek

Dunham Creek, a large second-order tributary to middle Monture Creek, flows south 13 miles through an alluviated glacial valley, joining Monture Creek at stream mile 11.5. Stream discharge was measured at 32 cfs at stream mile 2.5 on July 15, 1996. The land management in the drainage is administered by the Lolo National Forest. The channel is composed of laterally moving sand, gravel and cobble substrate, with point bars and a pool/riffle sequence of habitat in mid- to lower reaches. Portions of the stream are unstable with both aggraided and incised reaches.

The poor condition of the Dunham Creek fishery is a result of altered and unstable stream channels caused by poor riparian timber harvest practices of the past, dewatering in lower stream reaches, and entrainment of native fish into an irrigation canal.

The lower half of the Dunham Creek drainage has been logged extensively. In a 1.3 mile section from stream mile 3.5 to 4.8, channel alterations associated with poor logging practices have damaged the riparian area including the loss of stream sinuosity and channel incision. Dunham Creek annually dewater in this section. Possible changes in the channel geometry, channel stability and surface\groundwater interaction need further evaluation and development of corrective measures.

An unscreened irrigation canal, located below the spawning area, captures nearly 100% of Dunham Creek during the latter half of the irrigation season. In the summer 1995, the loss of juvenile bull trout, westslope cutthroat trout and a spawned, radio-tagged bull trout to this canal were documented. The loss of adult bull trout to the canal probably eliminates most repeat spawning in Dunham Creek and limits the reproductive potential of the population. Although the canal reduces downstream flows throughout the irrigation season, Dunham Creek is probably naturally intermittent below the headgate in late fall. The historical success of emigration by spawned bull trout was probably variable, depending from year to year on water availability. In

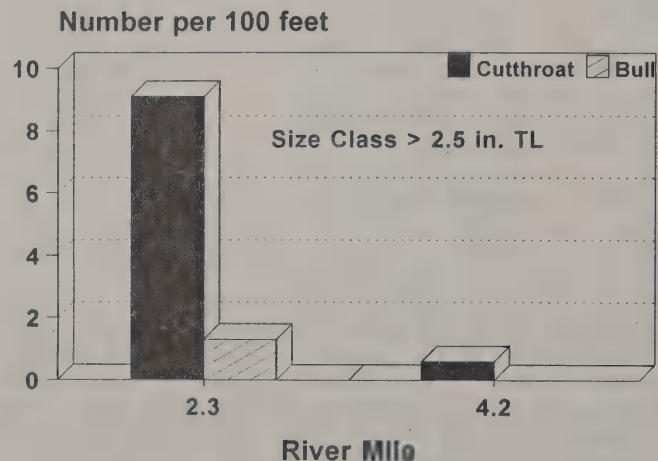


Figure 50. Estimated Densities of Bull and Cutthroat Trout in Two Sections of Dunham Creek, August 1996.

some river systems, fish depend on the stochastic occurrence of late-season rainstorms to provide passage to perennial sections. If the timing of the out-migration is tied to a slight pulse in the hydrograph, temporarily reducing or eliminating the amount of water entering the canal during major precipitation events may provide enough water for fish to return downstream.

Restoration objectives

- 1) Eliminating the loss of bull trout and westslope cutthroat trout to the irrigation canal.
- 2) restore habitat and migration corridors.

Restoration activities

In 1996, a fish screening project designed to keep all fish from entering the canal was initiated at the Dunham Creek Diversion. The project includes two main elements: 1) a self-cleaning flat-plate screen similar to those described for the North Fork project; and 2) bank stabilization for 300 ft section of C4 channel immediately above the project site located on the Lolo National Forest.

Fish Populations

Historical accounts indicate Dunham Creek and its principle tributary, Lodgepole Creek, contained a significant number of spawning fluvial bull trout. In 1995, a radio-tagged bull trout from the lower Blackfoot River migrated 45 miles to spawn in Dunham Creek. Five other bull trout redds were found near the spawning site of the radio-tagged fish, indicating a small population still exists.

Dunham Creek supports an impaired cutthroat trout and bull trout fishery over its entire length, with brook trout present in the lower reach. Four fish surveys were made in August 1996, including one survey in Lodgepole Creek, a tributary to upper Dunham Creek (Appendix, Exhibit A). The two surveys in the middle portion of Dunham Creek (RM 4.2 and 5.5) occurred in unstable channels. The upstream survey was in a perennial section with heavy bedload deposition. The downstream sample was taken in an incised channel that apparently has been mechanically altered. CPUE in both sections was extremely low. CPUE in the upper section was 0.3 and 0.3 for cutthroat trout and bull trout, respectively. The two bull trout sampled in this section were YOY. A two-pass population estimate in the middle section recorded cutthroat densities of 0.6 fish/100 ft. No bull trout were sampled. The third survey in Dunham Creek occurred in a stable perennial reach located at stream mile 2.3, 0.5 miles upstream of the Dunham Creek canal (Figure 50). Total densities of cutthroat trout in this section were estimated at 9.1 fish/100 ft and densities of bull trout >6 in were estimated at 1.3 fish/100 ft. Low numbers of brook trout were also present in the sample (Appendix, Exhibit C).

Bull trout redds were surveyed in lower Dunham Creek in 1995 and 1996; six redds were recorded in each year.

Elk Creek

Elk Creek, a third-order tributary, flows 14 miles northwest through a mineralized section of the Garnet Mountains before entering the Blackfoot River at river mile 28. Its base flow is 4 cfs. Extensive mining, including a century of placer mining in the upper drainage, has severely altered the channel. This land use, combined with channelization, road construction and maintenance activities, and poor drainage problems, continue to contribute large amounts of sediment to the stream.

Sections within the lower 5 miles of Elk Creek riparian corridor have been heavily grazed, creating unstable banks. According to local accounts, one mile of channel, from stream mile 1.8 to 2.8, was moved from its original location for irrigation in the 1940's. The channel was placed in the upland along the valley wall in glacial lake sediments of a clay type material. The result was vertical channel incision up to 10 ft that produced steep, highly erodible banks. The amount of stream channel sediment in this section was as

much as 900% greater than an upstream control section (BLM, unpublished data).

Water temperatures have been monitored at three sites in Elk Creek since 1994 (Figure 51). Average temperatures at the Sunset Hill Road site, RM 3.0, remained below 57°F and maximum temperatures here rarely exceeded 70°F. Average temperatures increased 3 to 4°F at the two downstream monitoring sites at Highway 200 and near the mouth (RM 1.1 and 0.1, respectively). While average temperatures at these sites remained below 61°F, large daily fluctuations in temperature occurred. Maximum temperatures at these sites during summer months were commonly >70°F. Large daily water temperature fluctuations are stressful for fish, especially trout.

Restoration objectives

- 1) Restore access from the Blackfoot River for spawning westslope cutthroat trout, bull trout, rainbow trout, and brown trout.
- 2) Eliminate significant sources of sediment.
- 3) Improve management of livestock grazing.

Restoration activities

Restoration efforts at two locations in Elk Creek began in 1991. An upstream project occurred at stream mile 12.2. This project, directed by the BLM, reconstructed a B4 channel in an area severely impacted by dredge and placer mining. In the lower portion of the creek (RM 1.3 to 2.9), initial efforts focused on reconstructing an 8,581 foot section of E4 channel, moving mature willows from adjacent areas, and adding large woody debris to the channel. The former channel was filled, recontoured and seeded. A deferred rest-rotation grazing system was initiated, with cross-fencing of riparian pastures and offstream watering sites. Further improvements to the management of riparian areas are currently being considered on private land in the lower 4.0 miles of stream. Changes in stream profile in both project areas are being monitored.

Fish Populations

Elk Creek supports a fishery dominated by rainbow trout in lower reaches and cutthroat trout and brook trout in upper reaches. The transition between the two fisheries occurs between stream mile 3 and 5. No bull trout have been sampled in Elk Creek, although they historically occurred here.

Six survey sections have been established in Elk Creek (RM 0.1, 1.1, 2.3, 3.0, 4.6 and 12.2). Lower sections (RM 0.1, 1.1, 3.0 and 4.6) were established in 1991 to provide baseline for channel reconstructions. These sections were duplicated after the projects were completed; two more sections were established in the newly constructed channels (RM 2.3, 12.2).

The species composition and density of trout in Elk Creek varies greatly. In 1991, estimated densities of rainbow trout in lower Elk Creek increased from 5 fish/100 ft at stream mile 0.1 to 56 fish/100 ft at stream mile 3.0 (Figure 52). In 1996 we found relatively no change in densities of rainbow at stream mile 0.1, but a decline in the fishery at stream mile 3.0. At river mile 3.0, brook trout densities have shown a significant decline from 27.8 to 1.6 fish/100 ft between 1991 and 1996. Rainbow trout also declined from 41.7 to 10.4 fish/100 ft (Appendix, Exhibit C).

At stream mile 4.3 in 1991 the CPUE was 0.8 for brook trout and 1.3 for rainbow trout. At stream mile 4.6 in 1996 the CPUE was dominated by brook trout with 43.8, followed by cutthroat trout with 10.5 and rainbow trout with 5.7.

At stream mile 2.3, the CPUE for rainbow trout improved from 1.3 in 1995 to 6.3 in 1996 (Appendix, Exhibit C). Six species were recorded in the sample including brook trout, brown trout, sculpins, longnose sucker, rainbow trout and cutthroat trout (possible rainbow hybrids). The density of sculpins was high, with multiple age classes present one year post channel construction.

Brook trout was the only species found at RM 12.2 in 1996, with a CPUE of 5.1 fish/100 ft.

Grentier Spring Creek

Grentier Creek is a small spring fed tributary to the Blackfoot River. It enters the upper Blackfoot River at mile 108, one mile south of Lincoln. The perennial section of the spring creek is 1.2 miles in length. The stream originates on the Grentier ranch from a series of spring ponds and seeps.

Past livestock grazing practices not sensitive to healthy stream banks and stream channel have reduced the overall quality and quantity of habitat in Grentier Spring Creek. This stream is primarily a groundwater fed system, lacking flushing flows, except below the mouth of Poorman Creek. In addition the channel is located in glacial outwash gravels with only limited top soil. Without channel maintenance via flushing flows, the cleansing and recovery of the middle and upper reaches may take considerable time if left to natural processes. The outwash gravels when and where exposed by the loss of top soils will take decades to re-establish good riparian vegetation and structure.

Restoration objectives

1) Restore habitat in stream channels between spring pond areas for

spawning, holding, and rearing of fish.

2) Deepen

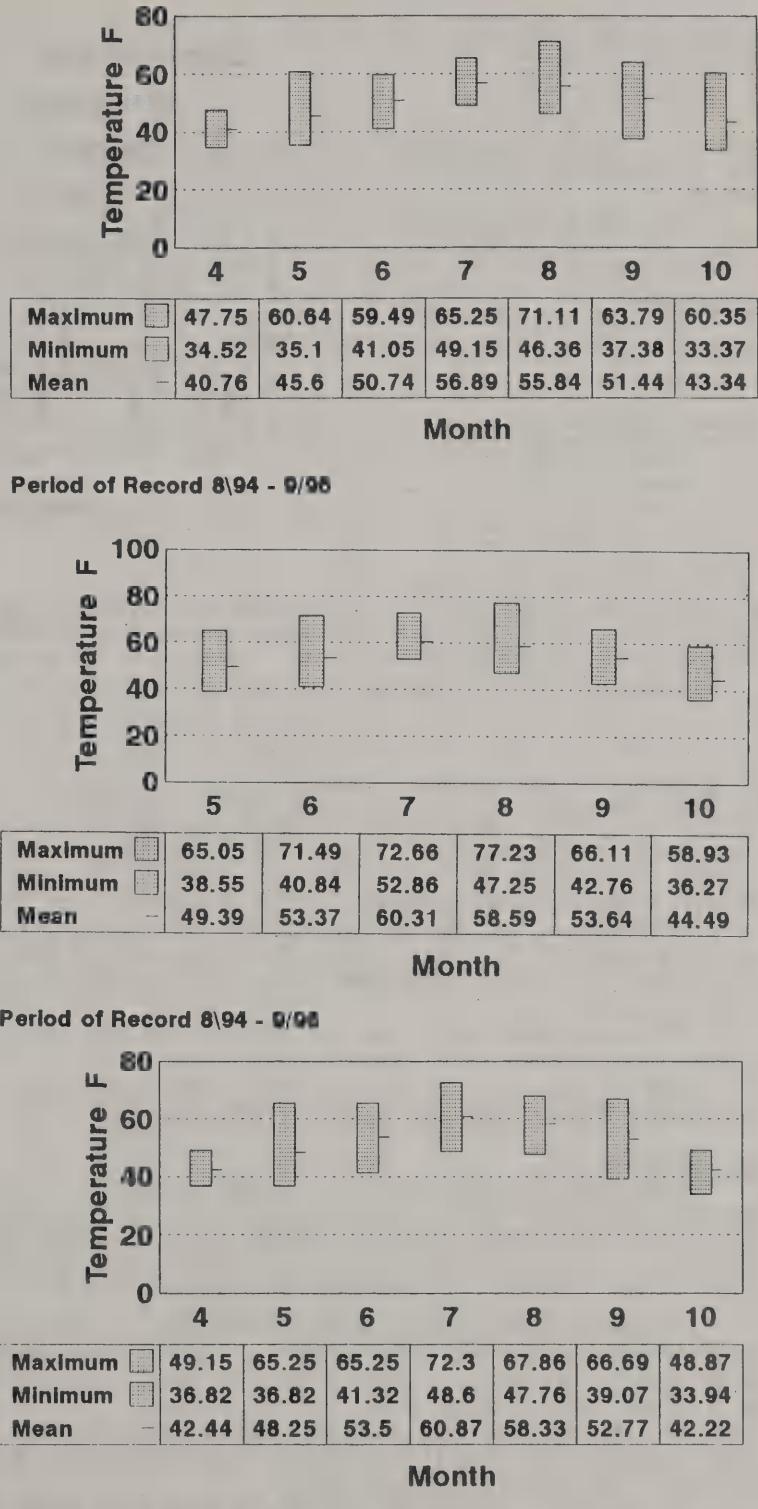


Figure 51. Summary of Water Temperature Monitoring at 3 Locations on Elk Creek, (Top) Sunset Hill Road, (Middle) Highway 200, (Bottom) Mouth.

spring ponds and add permanent cover to increase large fish security and improve numbers of larger fish throughout the system.

3) Implement stream sensitive grazing and forage production strategies.

4) Establish reproducing westslope cutthroat fishery.

Restoration activities

Grentier Spring Creek was the first "large" stream restoration project implemented in the Blackfoot River drainage as part of the 1990's Blackfoot River fishery project. Initial work was completed in the spring of 1991 on the upper reaches of the system. Additional entries have occurred to complete lower system work along with fine-tuning and corrective actions on some of our initial efforts. Stream channel restoration was completed on 1.1 mile of channel. Most of the activity involved narrowing the channel, constructing pools, and planting bank vegetation. All five ponds were deepened in limited areas, and permanent cover added. Permanent fish ladder/grade stabilizing structures were placed on four of the ponds. A permanent outlet for the fifth pond is scheduled for construction in the spring of 1997. One of the major challenges of the work was the disposal of large quantities of dredged gravels out of visual sight and in a manner that was fully reclaimable to pasture/hayland. We also developed low impact methods of moving heavy equipment in and around the riparian areas.

This project provided valuable lessons in construction and planning related activities for the major stream restoration efforts that followed.

Most funding for the project came from the landowners on the creek, but some funds came from the BBCTU, FWS, and FWP.

Fish Populations

Grentier Spring Creek is predominately a brown trout fishery with low numbers of large fish. The system also has good numbers of brook trout present and very low numbers of cutthroat trout present. According to landowner accounts, the spring creek historically supported bull and cutthroat trout.

A population survey was undertaken in Grentier Spring Creek 2 years after initial habitat enhancement. Density estimates were obtained for brook trout and brown trout. Brook trout densities were 57.0 and 5.4 fish/100 ft for YOY and age 1 plus fish, respectively. Brown trout densities were 53.1 and 7.8 fish/100 ft for YOY and age 1 plus fish. The CPUE for brook and brown trout ranked third and fourth for the Blackfoot River drainage between 1990 and 1996 (Appendix, Exhibit A).

An attempt to establish westslope cutthroat in the upper most pond was attempted by removal of competing brook and brown trout with electrofishing gear and the introduction of cutthroat trout from nearby Humbug Creek. Humbug Creek is the origin of the Grentier Spring Creek, water but direct surface connection no longer exists between the two. A screen was placed at the outlet of the pond to prevent upstream movement of fish back into the pond.

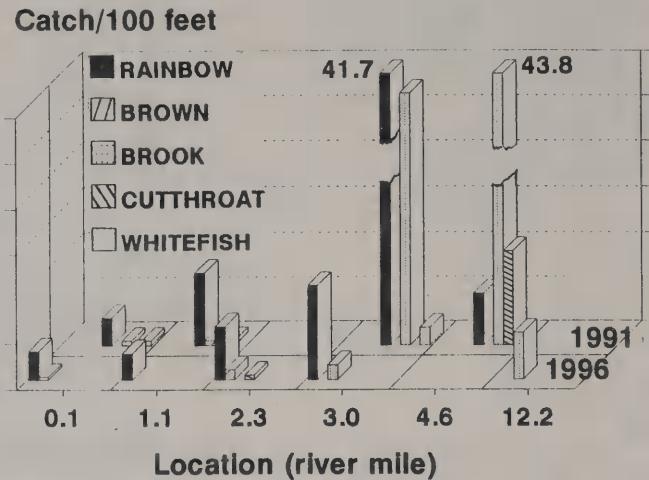


Figure 52. Electrofishing Catch per 100 feet at 6 Locations on Elk Creek, 1991 and 1996.

The screening appears to have failed and the results of the introduction have not yet been evaluated.

Hoyt Creek

Hoyt Creek, a small spring creek tributary to lower Dick Creek, originates from alluvial aquifers located immediately north of Ovando. Hoyt Creek flows four miles in a northwest direction through agricultural ranch lands. The topography of the area consists of knob-and-kettle terrain. The base flow of Hoyt Creek is estimated at 2 to 3 cfs. The stream loses water to four irrigation canals and receives water from two return-flow channels. Water temperature can exceed 70°F in lower reaches. The stream flows through several culverts, some of which are set above stream base level and contribute to stream widening and sediment deposition.

Once Hoyt Creek enters hay meadows and pasture lands, woody riparian vegetation becomes sparse. Near the mouth, gradient increases slightly and a small cold spring enters. Both improve habitat conditions for small fish.

Restoration objectives

- 1) Improve habitat suitable for all salmonids in system.

Restoration activities

Cross fencing and offstream watering areas area being developed. Six culverts have been pulled on the stream and replaced with bridges, improving fish passage and reducing levels of sediment. Two diversion structures have been modified in order to allow better passage for fish and restore natural stream grades at the diversion locations.

Fish Populations

Three fishery survey sections were established in July 1992. An upstream section was established near the source, a middle section at Highway 200 and a third section near the mouth. The upstream sample revealed a resident brook trout fishery with CPUE of 14.5. No other fish species were found. No fish were found in the middle section. The mouth section samples revealed a mixed fishery of brook trout (CPUE 11.0), rainbow trout (CPUE of 6.0), whitefish (CPUE of 5.0), brown trout (CPUE 1.0), cutthroat trout and longnose sucker (both with CPUE of 0.5). All rainbow, brown and cutthroat trout were juvenile fish, including YOY brown trout and rainbow trout.

Kleinschmidt Creek

Kleinschmidt Creek is a 2.6 mile spring creek that joins lower Rock Creek at stream mile 0.1. This stream drains the southern portion of Kleinschmidt Flat, and flows west before joining Rock Creek. The habitat was recorded as deteriorated in 1991 (Pierce 1991). Kleinschmidt Creek has a history of intensive riparian grazing. Woody riparian vegetation was scarce, resulting in lack of instream woody debris, undercut banks and instream cover. A series of rock dams also raised the base level at several locations, forming a stair-stepped appearance with long flat pools separated by short sections of over-widened, high-gradient stream. Rock dams increase water velocities in the near bank, further widening the channel, and caused deposition of fine sediment over its gravel base.

Restoration objectives

- 1) Restore stream channel morphology for habitat for all life stages of trout.
- 2) Increase recruitment of trout to the Blackfoot River.

Restoration activities

In 1991, a 1,200 foot section of lower Kleinschmidt Creek was the focus of a fishery restoration effort. The project included reconstructing the channel and enhancing fish habitat. Rock dams were removed, allowing the

stream to reestablish natural meander patterns and expose underlying gravel. Pools were also excavated and woody debris added to outside stream bends. Shrubs and conifers, including mature stocks, were transplanted from an adjacent site to accelerate recovery of the riparian area.

Fish Populations

Kleinschmidt Creek supports brown trout, with lower numbers of rainbow trout, brook trout and cutthroat trout. According to historical accounts, this stream supported bull trout. According to landowner observations, the resident brown trout fishery has improved since restoration activities, and reproduction is occurring in the project area.

Pre- and post-project fish surveys were taken in the lowermost portion of the project area. CPUE for YOY brown trout increased from 10 in 1989 to 72 in 1994, three years after project completion. This CPUE for YOY the highest recorded in the Blackfoot River drainage. CPUE for rainbow trout increased from 0.4 to 12 during this same period. A population survey for YOY in 1994 estimated densities at 275 fish/100 ft and 16 fish/100 ft for brown trout and rainbow trout, respectively. This survey also recorded very low numbers of age 1 plus fish, indicating emigration and/or high mortality of juvenile fish.

Nevada Creek

Nevada Creek is a major tributary to the Blackfoot River at RM 67.8. It flows through a wide valley comprised of alluvial outwash in it's lower 12 miles (Figure 54). Historically, this reach was probably a beaver wetland complex but has now been converted to hay/grazing meadows maintained through active control of beaver. The channel is predominately an E6 channel type with some C3 near the mouth. Nevada Creek contributes a significant amount of water to the overall stream flow of the Blackfoot River during low flow periods. Stream flow of Nevada Creek in November of 1989 was 43.8 cfs at the mouth, equivalent to 39.7 % of the Blackfoot River flow. Unfortunately impaired water quality in Nevada Creek including: high temperatures, high nutrient loading, and high levels of sediment decrease, rather than enhance, water quality in the Blackfoot River. The fishery is dominated by non-game species that are more tolerant to the impaired conditions than trout. Historical accounts of the Nevada Creek fishery indicate a highly productive system with large native fish species being common.

After leaving the wide valley upstream of RM 12, Nevada Creek enters a narrower alluvial valley before entering Nevada Reservoir at RM 31.7. Nevada Reservoir was built in 1938.

Management of water releases from Nevada Reservoir appears to have been a significant contributor to unstable channel and impaired fishery conditions in Nevada Creek. Annual dewatering of the stream channel in July, coupled with alteration of the bankfull discharge create a very unstable environment in which fish have to survive. The stream channel is a degraded E channel type, with characteristics of C and F channels that subjects this channel and it's banks to extreme high erosion potential. The addition of grazing animals to the over-steepened banks during bank-wet seasons accelerates erosion and mass-wasting of the banks.

Upstream of Nevada Reservoir the stream gradient increases markedly. The stream channel is predominately a C3 type with generally improving bank conditions. A trout fishery reappears, with brook trout dominating reaches immediately upstream of the reservoir and westslope cutthroat in the headwaters.

A riparian inventory of Nevada Creek was conducted below the reservoir using methods developed by the Bureau of Land Management and Montana Riparian and Wetland Association (Fitzgerald 1996). Objectives of this study were to assess and map the riparian health of lower Nevada Creek by management unit. Management units were based on land ownership, and management changes within individual ranches. Indices of overall riparian health were generated for each unit using measurements of vegetation, soils, geology, hydrology and

stream banks. Results indicated 53% of the riparian zone was "at risk", 46% was "unhealthy" and 1% "healthy". In general, Nevada Creek below the reservoir had a lower health rating than areas near the mouth due to the lack of shrubs along the bank, minimal deep-binding root masses and lateral erosion of 80% of stream banks (Fitzgerald 1996). This information will aid setting priorities for restoration projects and will provide baseline conditions to monitor improvements. Copies of this report are available at the Conservation District and NRCS.

Water temperatures have been recorded at four locations in Nevada Creek since 1994 (Appendix, Exhibit G). During the irrigation season, Nevada Creek Reservoir reduced average stream temperature immediately below the reservoir; maximum temperatures recorded at a station here remained <70°F. Average summer temperatures increased up to 8°F between this station and the next station, located upstream of the Douglas Creek confluence; summer maximum temperatures here exceed 70°F. Douglas Creek caused average and maximum temperatures in Nevada Creek at a station immediately downstream of the confluence to further increase 2°F and 9°F, respectively. Water temperatures remained high downstream to the confluence with the Blackfoot River. Nevada Creek appears to influence water temperature in the Blackfoot River: August average temperatures at a monitoring station 7.5 miles downstream of the confluence averaged 2°F warmer than a station 3.4 miles upstream of the confluence.

Restoration needs

Nevada Creek has been identified as a major source of non-point pollution to the Blackfoot River (Ingman et al. 1990). Water temperatures in it exceed 79.4°F. Nevada Creek has high levels of suspended organic sediments, and very low densities of trout (Ingman et al. 1990, Peters 1990, Rothrock 1996). The management of water releases from Nevada Reservoir needs to be addressed to alleviate both stream channel degradation and fishery impairment below the reservoir. The reservoir's primary purpose is for storage of irrigation water and serves several agricultural producers with water. We suspect that solutions can be found to the above mentioned problems to the benefit of all water users, landowners along Nevada Creek, and the fishery resource.

Restoration objective

- 1) Restore water quality and fish habitat to levels suitable for trout.

Restoration activities

In 1990, the Nevada Creek Watershed Improvement Project began with the North Powell Conservation District coordinating contacts and projects on private ranch lands. Restoration of non-point pollution will require long-term efforts, but can be accomplished with landowner cooperation. EPA 319 Non-Point Pollution Source Program has provided the bulk of funds used to improve land-use, water quality and reservoir management. By 1996, 12 livestock producers have developed plans to improve grazing systems. The FWP has supported this effort by coordinating assessments of riparian health, supporting additional funding to NRCS programs directed toward these activities and by collecting baseline data on water temperature and fish populations.

Fish Populations

Fish populations were sampled in 11 sections of Nevada Creek from 1990 to 1996 (Figure 53). Only one brown trout was sampled in four shocking sections totaling 21,484 ft of sampled stream in the lower 31 miles of Nevada Creek (Appendix, Exhibit A). Largescale suckers and longnose suckers were the most abundant species in this section of stream. The sampled densities of these species were the highest recorded in any tributary stream to the Blackfoot River in six years of sampling. Rainbow trout were present in low densities ranging from 0.2 to 0.8 fish/100 ft, but only in samples located immediately downstream of Nevada Reservoir. These fish had likely moved from



Figure 53. Fishery Survey Locations for Nevada Creek and 13 other Tributaries in the surrounding area.

the reservoir.

Five sections above Nevada Reservoir, (RM 31 to 42.1), were sampled in 1996; four of these sections duplicated sites sampled in 1957 (Appendix, Exhibit A). In the 1957 samples, cutthroat trout were present at RM's 31, 33, and 40.8 and bull trout were present at RM's 33 and 40.8. A 19 inch bull trout was sampled at RM 40.8; the size of this fish suggests it was fluvial. In the 1996 samples, brook trout were the most abundant salmonid, with estimated densities of 2.0 to 11.3 fish/100 ft, but were not present in the upstream-most sample at RM 42.1. Cutthroat trout were present (1.0 to 4.4 fish/100 ft) in the upper two sections at RM's 40.8 and 42.1, and no longer present in samples at RM's 31 and 33. No bull trout were sampled in any sections in 1996.

Nine tributaries to Nevada Creek have been sampled by the Helena National Forest since 1988. Of these nine, all contained cutthroat trout and six contained no other trout species. Some of these populations were hybridized with rainbow trout and possibly Yellowstone cutthroat trout (L. Walsh, Helena National Forest personal communication).

Nevada Spring Creek

Nevada Spring Creek, located on the eastern edge of the lower Nevada Creek valley, flows from a single-source artesian aquifer with a constant summertime flow of 10 to 11 cfs. At the spring source, summer temperatures range from 44 to 45°F. Immediately below the source, Nevada Spring Creek enters the alluvial plain of the lower Nevada Valley where stream gradient quickly drops and the stream assumes a meandering course for 3.2 miles before entering Nevada Creek at stream mile 6.2.

A habitat survey conducted for Nevada Spring Creek in 1990 reported a deteriorated condition. Beginning 0.6 miles below the source Nevada Spring Creek stream width increases from an average of 29 ft to 57 ft in middle reaches. The survey reported a wide, shallow, heavily silted stream with poor stream bank conditions. Substrate quality was poor due to excessive sediment, except immediately below the spring source. In lower reaches, limiting factors included lack of spawning areas, inadequate pools, riffles and undercut banks (Pierce 1991). An inventory rated riparian health of Nevada Spring Creek as "unhealthy" over the entire length (Fitzgerald 1996). Temperature studies in lower stream reaches indicate summertime stream temperatures elevated beyond levels considered optimal for trout. Poor habitat quality severely limits reproduction, recruitment of adult fish able to inhabit downstream reaches of the stream.

Nevada Spring Creek is one of our highest priority streams for restoration in the Blackfoot River. It has the potential to 1) significantly improve fish recruitment in a recruitment poor reach of the Blackfoot River; and 2) significantly decrease water temperatures in the Blackfoot River during the summer low flows period.

Restoration objective

- 1) Restore habitat suitable for cold water trout fishery.

Restoration activities

In 1990, habitat restoration project was developed for a 0.75 mile section of the spring creek. The project included fencing livestock from the stream, planting willows in the riparian area, and installing woody debris in the stream. Conifer bundles were placed along the inside of stream bends to force the deposition of sediment and speed the process of stream narrowing.

Fish Populations

Fishery surveys in 1990 recorded a brown trout dominated fishery in upper reaches, with low numbers of westslope cutthroat trout, largescale sucker and sculpins also present. Cutthroat trout in Nevada Spring Creek originate from Wasson Creek. Multiple size classes of brown trout were present, but poorly represented in the upper spring creek. YOY brown trout were captured in the upper spring creek, indicated successful reproduction in this area. Salmonids were absent from samples taken in lower Nevada Spring Creek.

Pre- and post-treatment surveys (from 1990 through 1994) occurred in the

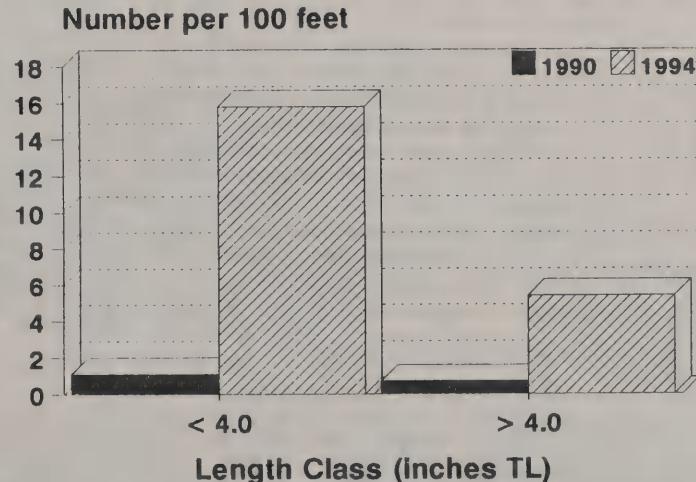


Figure 54. Estimated Densities of Brown Trout for Nevada Spring Creek, 1990 and 1994.

project area near the spring source (Figure 54). During this monitoring period, densities of YOY and age 1 plus brown trout showed a significant increase. YOY densities increased from 1.1 to 15.8 fish/100 ft, while age 1 plus brown trout numbers improved from 0.7 to 5.4 fish/100 ft. Spawning surveys for brown trout showed a significant increase in spawning activity post-treatment. Redd numbers increased from none in 1990 to 51 in 1993.

Pearson Creek

Pearson Creek, a second-order tributary to lower Chamberlain Creek, originates in the Garnet Mountains and flows north 9 miles, joining Chamberlain Creek at stream mile 0.2. This stream is a confined and high-gradient, flowing through a series of plunge, step and lateral pools in its mid- to upper reaches. In lower reaches, gradient drops quickly as the stream enters the high river terrace. Upon leaving the mountains, the lower reach of Pearson Creek skirts the northern edge of a foothill/terrace interface. In this reach, Pearson Creek flows through beaver-created wetlands and mixed coniferous forest. The lower section of Pearson Creek was removed from its natural channel and channelized for irrigation. As a result, the lowermost portions of the creek dissipated into a sedge meadow before entering the Blackfoot River, isolating resident trout while inhibiting tributary access of fluvial fish.

Restoration objectives

- 1) Reclaim the original channel and return the stream to it.
- 2) Restore access to the Blackfoot River for westslope cutthroat trout.
- 3) Increase stream flow in lower Chamberlain Creek to attract spawning trout.

Restoration activities

Lower Pearson Creek was returned to its historic channel and reconnected to Chamberlain Creek in 1994. To restore the habitat in this portion of the stream, woody debris was added to the channel and mature riparian shrubs were transplanted to the stream banks. Other major elements to this project were 1) restoring Basin Creek, a degraded tributary to the historical channel of lower Pearson Creek; and 2) restoring an instream, nine-acre wetland located 500 ft above the Pearson Creek confluence, and 3) fitting fish passage facilities at the wetland berm.

Upstream from the Basin Creek confluence, restoration efforts consisted of constructing three segments of an E4 channel type and connecting these to existing segments of historical channel. Woody debris was also placed in the channel and vegetation planted to stabilize streambanks. Changes to the management of riparian grazing in the lower 2 miles were also made, including fencing one mile of stream and planting native shrubs. In mid- to upper reaches of Pearson Creek, Plum Creek Timber Company has deferred grazing on their properties. Further cooperative enhancement measures are now being considered in the middle section of Pearson Creek.

In 1996, the same landowner who donated the Chamberlain Creek water lease, donated a separate water lease for the entire Pearson Creek flow. This water lease ranges from a base flow of one cfs to eight during runoff periods.

Fish Populations

In September 1991, the fishery in the lower 1.5 miles of the existing Pearson Creek was surveyed. CPUE for cutthroat trout was 14 at RM 1.6, but dropped to less than 1 fish in the channelized lower portion of Pearson Creek. Genetic sampling shows cutthroat trout in lower Pearson Creek have a slight degree of hybridization (Leary 1994). The downstream movement of emigrating cutthroat trout has been documented in the newly reconstructed channel. A cutthroat fishery is developing in the wetland area below the Basin Creek Spring source.

Rock Creek

Rock Creek, the main tributary to the lower North Fork of the Blackfoot River, is formed by the confluence of Salmon and Dry creeks on the northeastern edge of Kleinschmidt Flat. This stream flows 8.2 miles in a south-westerly direction, joining the North Fork of the Blackfoot River at RM 6.2. Its flow measured 53 cfs on July 24, 1989. Kleinschmidt Creek joins Rock Creek immediately upstream of the North Fork junction. Rock Creek occupies a channel historically formed by a braided glacial outwash stream. Upper Rock Creek skirts the foothills on eastern edge of Kleinschmidt Flat (RM 5 to 8) before entering the Flat where it losses water to alluvium and irrigation. In the lower portion of Kleinschmidt Flat, groundwater surfaces, forming the spring creek portion of Rock Creek.

Rock Creek is in degraded condition, except in areas where habitat restoration has recently occurred. Under natural conditions, the Rock Creek channel type is generally stable if well vegetated, unless stream banks are damaged. Groundwater inflows and saturated streambanks in this channel type increase sensitivity to bank damage.

A habitat survey was completed in 1990 on the lower 1.4 miles of stream (Pierce 1991). This survey recorded a shallow, wide stream. Lack of pools and instream cover, dewatered sections, barriers to fish passage, and loss of woody riparian vegetation were factors limiting the fishery. Irrigation practices, irrigation diversion structures, culvert crossings, livestock grazing, tilling streambanks and riparian timber harvest all contributed to the poor condition of the stream.

In 1994, another habitat inventory was completed from RM 1.4 to 8.2. The condition of the stream and riparian area in this section was severely degraded, being extremely wide and shallow. Livestock had sheared wet banks. Logging has also impacted the stream channel, as evidenced by the lack of instream woody debris and mature riparian trees. A representative cross section profile of the channel at mile 3.7 had a base flow wetted width of 35 ft and a maximum depth of 6 in. According to our measurements, normal bankfull channel width and depth for this channel type (E5) are 8 ft and 18 in, respectively.

Restoration objectives

- 1) Remove barriers to fish migration.
- 2) Restore natural stream morphology to improve rearing and spawning habitat for all fish using the system.

Restoration activities

High potential for improved fisheries through restoration and a motivated landowner provided the catalyst for a comprehensive restoration project on lower Rock Creek. Restoration activities began in the lower 1.2 miles of Rock Creek in 1990. Six barriers to fish passage (culverts, dams and diversions) were removed and more efficient diversion structures created at two headgates. Conversion from flood to sprinkler irrigation was made, improving water management and conservation, and allowing increased stream flows in 900 ft of channel. Stream habitat was enhanced by narrowing the channel, adding woody debris and planting riparian shrubs and conifers over the entire length of the project. Management of livestock grazing in riparian areas has improved.

At the upper end of Rock Creek, a 1.8 mile habitat restoration and enhancement effort (RM 6.4 to 8.2) was undertaken beginning at the confluence of Dry and Salmon creeks in 1996. The project focused on restoring stream dimensions and habitat features to E4 and E6 channel types. This and adjoining downstream projects include improved riparian grazing management using deferred and rotational grazing systems for three miles of upper Rock Creek. Changes to riparian management also include developing offstream watering sites, improving livestock fords and planting riparian shrubs.

Water conservation measures are now being considered in the Salmon Creek drainage which if implemented should improve stream flows in Rock Creek.

Fish Populations

The fishery in Rock Creek is dominated by rainbow trout and brown trout, with low numbers of brook trout and very low numbers of cutthroat trout and bull trout in lower reaches. The relative abundance of cutthroat trout and brook trout increases in the upstream direction (Appendix, Exhibit A). Rock Creek historically supported spawning migrations of bull trout and cutthroat trout, and also was a migration corridor between the North Fork Blackfoot River and the Coopers Lake and upper Dry Creek drainages.

Baseline fishery information was collected in four sections of lower Rock Creek in 1989 (Peters 1990). In 1994, the same sections were resurveyed. Survey results showed an increasing abundance of rainbow trout, brown trout and brook trout in all sections. Juvenile bull trout, absent from the 1989 survey, were present in very low numbers in the upper portion of the project area in 1994.

Pre- and post-project population surveys were made at RM 0.7 in 1990 and 1994. The survey section was located in a channel segment with a history of dewatering and was upstream of three barriers to fish passage. Densities of YOY brown trout increased significantly from 6.4 to 42.9 fish/100 ft from 1990 to 1994. Brown trout one year of age and older increased from 0.0 to 2.3 fish/100 ft. Rainbow trout one year of age and older also increased from 0.6 to 1.9 fish/100 ft (Appendix, Exhibit C). A CPUE for YOY rainbow trout at this location was 0.2 in 1990 compared to 28.1 in 1994. A mature 20 inch bull trout moved into lower Rock Creek in 1994 and occupied the upstream pool of the project area from early to mid-summer. This fish could not ascend further due to an extremely shallow channel immediately upstream of the project area. The timing of entry into Rock Creek by this fish may indicate the migratory life-history form still exists in the upper drainage.

Two other baseline population surveys were completed in two future project areas (RM 6.4 and 7.5) during summer 1996. These samples were taken in sections heavily damaged by livestock; riparian vegetation and fish habitat were in poor condition. Brook trout \geq 4.0 in. TL were the most abundant trout with an estimated density of 3.6 to 7.0 fish/100 ft. Cutthroat trout were present in low numbers: densities of YOY ranged from 0.0 to 1.5 fish/100, and age 1 plus from 0.2 to 1.7 fish/100 ft (Appendix, Exhibit C).

Salmon Creek

Salmon Creek, the outlet stream to Coopers Lake, flows 1.7 miles to its union with Dry Creek; the confluence of these streams forms Rock Creek. Salmon Creek contributes the majority of the upper Rock Creek discharge during base flow periods. Coopers Lake is a 300-acre oligotrophic, glacially-formed lake. Due to natural regulation of flow from the surface of the lake, Salmon Creek maintains fairly stable flows, very clean substrate, low turbidity and low levels of nutrients. Immediately downstream of the outlet, Salmon Creek enters a steep, heavily forested canyon where it cascades through confined step/pool series of boulders and cobble. Gradient drops quickly at the mountain-Kleinschmidt Flat interface. Salmon Creek enters Spawn Lake, a small irrigation reservoir. Downstream of Spawn Lake, Salmon Creek is an impaired low gradient, slightly sinuous, meadow stream with gravel substrate. Stream flow measured 32.9 cfs at Spawn Lake on June 22, 1995.

The fishery in Salmon Creek is impaired due to poor fish passage, losses of fish to irrigation canals, dewatering of the stream channel, channel alterations and past streamside management. The Spawn Lake outlet structure regulates irrigation withdraw from Spawn Lake and prevents the upstream movement of fish. One quarter mile downstream of Spawn Lake, another irrigation canal diverts additional flow from the stream. This diversion structure also inhibits the upstream movement of fish. Both diversions entrain fish. During the month of June, these diversions take 13 to 19 cfs from the stream to irrigate approximately 410 acres, 60% with sprinklers.

Habitat in lower Salmon Creek has been impacted by alterations to the channel and past land-use practices. Lack of instream woody debris has reduced habitat complexity. Rock dams exist, creating a widened channel,

simplifying habitat, and causing deposition of fine sediment. A corral adjacent to the stream has damaged the streambank and contributed sediment and animal waste to the stream. A 2,000 foot section of middle Salmon Creek also was channelized, creating a linear, uniform stream lacking habitat features.

Restoration objectives

- 1) Restore natural stream channel morphology to improve spawning and rearing habitat for trout.
- 2) Restore migration corridors for native fish.
- 3) Improve recruitment of trout to the Blackfoot River.

Restoration activities

In 1996, a Denil fish ladder was fitted to the outlet structure of Spawn Lake. A comprehensive fishery improvement project, including more fish passage facilities, habitat enhancement, increased stream flows and changes to streamside management has been developed and is scheduled for implementation during the 1997 field season (Appendix, Exhibit F).

Fish Populations

The Salmon Creek system supports brook trout and low densities of cutthroat trout and bull trout. Three sampling sections were established on Salmon Creek and two established in irrigation canals. Sections in the stream were located downstream of the outlet to Coopers Lake, downstream of Spawn Lake, and in the channelized reach near the confluence of Salmon and Dry creeks. Brook trout:

5.3); cutthroat trout

in lower numbers. Cutthroat trout YOY were sampled downstream of Coopers Lake and juvenile bull trout were found immediately downstream of Spawn Lake. Longnose dace, sculpins and crayfish were common throughout the system. Among all samples, the highest CPUE rates were recorded in the irrigation canals (Appendix, Exhibit A).

Shanley Creek

Shanley Creek, a second-order tributary to Cottonwood Creek, flows south nine miles through forested mountains and low-relief knob-and-kettle topography, including alluvial outwash. It enters Cottonwood Creek at RM 5.6. Base flow measured 2.0 cfs on November 13, 1991. Land use in the drainage consists primarily of timber harvest in mid- to upper portions, and livestock grazing and hay production in mid- to lower portions. The lower two miles of Shanley Creek flows through land managed by the Bandy Experimental Ranch, owned by the Montana University system.

Three irrigation diversions and one irrigation pump pull water from the lower 1.6 miles of Shanley Creek. Two of these diversions entrain fish. The harvest of riparian timber has reduced recruitment of large woody debris to the channel, simplifying habitat. Livestock grazing has also damaged streambanks and caused sediment to accumulate in portions of lower stream reaches. Bollman (1996) reported moderate impairment of macroinvertebrate community in the lower reach.

Restoration objectives

- 1) Restore habitat for all fish species.
- 2) Restore migration corridors for native species.
- 3) Reduce losses of fish to irrigation canals.

Restoration activities

The University of Montana, Montana State University, FWP, and FWS are cooperating on two projects to improve riparian areas and fisheries on the Bandy Experimental Ranch. An exclosure fence was constructed on the lower 0.5 miles of Shanley Creek in 1994 to measure the effect of livestock grazing on the riparian plant community. This project also includes pre- and post-treatment monitoring of the fishery. A second project installed an

"experimental", self-cleaning paddle wheel-driven fish screen on a diversion canal to the Bandy Reservoir. This project was designed to reduce loss of westslope cutthroat trout to the reservoir canal. The Bandy Ranch is implementing a study of grazing BMP's for riparian areas located in the middle portion of drainage.

Fish Populations

Brown trout are the most abundant trout in the lower one mile of stream. A transition to a cutthroat trout and brook trout fishery occurs at approximately RM 1.0 (Appendix, Exhibit A). Bull trout are not present in recent samples, although local residents report catching spawning adults in the 1960's. Bull trout currently exist in all drainages adjacent to Shanley Creek.

Three monitoring stations were established in the lower stream, RM's 0.2, 1.4 and 1.6, and one station established in a canal to the Bandy Reservoir. Two stations, RM 0.2 and 1.4, and the canal station, were established in 1993. The third, RM 1.6 was established in July 1996 to provide baseline fisheries information for the study of grazing BMP's; it is located immediately downstream of a major diversion.

The monitoring station at RM 0.2 was established prior to the exclusion of livestock from the streambank; this section was resurveyed in 1996, two years post-treatment. Over this time, densities of brook trout ≥ 4.0 in. TL increased from 1.7 to 8.0 fish/100 ft and brown trout densities ≥ 4.0 increased from 2.3 to 4.5 fish/100 ft. The station at RM 1.4 is located immediately upstream of a diversion. The density of cutthroat trout ≥ 4.0 in. at this location was 4.1 fish/100 ft and the density of all brook trout 10.9 fish/100 ft. The density of cutthroat trout ≥ 4.0 in. at RM 1.6 were 2.6 fish/100 ft and the density of brook trout ≥ 4.0 in. TL 5.6 were fish/100 ft, approximately double the density of cutthroat trout.

The irrigation canal at RM 1.6 was sampled in 1993 to assess the number of entrained fish. This canal was screened in 1994, and resampled in July 1996. Juvenile and adult cutthroat trout and brook trout were sampled in the ditch prior to screening, but only YOY brook trout were sampled below the screen in 1996 (Appendix, Exhibit A).

Warren Creek

Warren Creek, a second-order tributary to the middle Blackfoot River, originates on the north side of the Ovando Valley and flows southwest 14 miles to its confluence with the Blackfoot River at RM 50. Its base flow is an estimated 5 cfs. Warren Creek flows through knob-and-kettle topography, alluvial outwash plains, and ranch lands. Its water is used for irrigated hay production and livestock watering. Irrigation withdraw causes the middle section of Warren Creek to dewater, but the lower section is influenced by springs and remains perennial.

Some riparian areas in the mid- to lower portion of the stream have been cleared, heavily grazed, dredged and straightened. These activities have destabilized banks, elevated sediment levels, lowered stream flows and formed barriers to fish passage. Several culverts and irrigation structures have also altered channel dimensions and created fish barriers in lower portions. A fish kill was reported in lower Warren Creek on June 23, 1992, probably a result of dewatering and temperature stress. Riparian management and condition of stream habitat improves dramatically in the lower half mile of the stream.

Restoration objective

- 1) Restore riparian vegetation and stream habitat for all life cycle stages of fish.
- 2) Improve recruitment of trout to the Blackfoot River.

Restoration activities

A cooperative effort to improve water quality and fisheries on four

ranches along Warren Creek has occurred since 1991. Through 1996, completed projects include removing three feedlots from the stream, removing three fish passage barriers (two culverts, one irrigation dam) in lower Warren Creek, implementing improved riparian grazing BMP's by cross fencing pastures, developing riparian pastures, developing offstream livestock watering for four miles of stream and planting shrubs along 1 mile of the lower channel.

Fish Populations

Warren Creek supports a brook trout fishery in middle reaches and mixed fishery in lower reaches. The fish population in this stream has been surveyed in five sites since 1991. Three sites were established in lower reaches, (RM's 0.1, 0.4 and 1.1), and three in middle reaches, (RM's 3.6, 4.9 and 8.2). In the lower sections, surveys revealed a mixed fishery comprised of mountain whitefish, brown trout, and rainbow trout. Densities of these three species declined in upstream sections: CPUE for mountain whitefish declined from 25.8 at RM 0.1 to 5.6 at RM 0.4. CPUE for brown trout declined from 12.9 at RM 0.1 to 3.7 at RM 1.1. CPUE for rainbow trout also decreased from 5.9 to 0.5 at RM 1.1. Low numbers of brook trout, longnose sucker and largescale sucker were also recorded in these samples (Appendix, Exhibit A).

A diversion structure creates a barrier to fish passage at RM 2.0. Above the structure, low numbers of resident brook trout comprise the trout fishery; longnose suckers are also present. The abundance of brook trout in Warren Creek increases to 11.7 fish/100 ft at RM 8.2. One mature cutthroat trout was also sampled in this section.

West Twin Creek

West Twin Creek is a basin-fed, third-order stream originating from the slopes of Wisherd Ridge and Sheep Mountain in the Lolo National Forest. It flows southerly through foothills and a mixture of Plum Creek Timber Company and private land to its confluence with the Blackfoot River at RM 10.6. A grade control structure installed above the Highway 200 culvert crossing failed to include fish passage design features and is a fish barrier.

Restoration objective

- 1) Modify a stream grade control structure at a stream crossing to include plunge pools for accommodating fish movements through the structure.

Restoration activities

Migration routes and plunge pools were created in the structure as part of mitigation for channel disturbance on a local highway project. No project evaluations have been completed on this project.

Fish Populations

Fish population samples were collected in August 1996 at RM 0.1. A mixed fish population was comprised of rainbow trout (CPUE of 3.1) and cutthroat trout, brook and brown trout (CPUE's of 1.5 each). This mixed species assemblage may indicate successful migration through the grade control structure.

RESULTS: PART IV

ADDITIONAL FISHERY INVESTIGATIONS ON BLACKFOOT RIVER TRIBUTARIES

Arrastra Creek

Arrastra Creek is a second-order stream entering the Blackfoot River at RM 88.8. The stream is 13 miles long. Its headwaters are mostly high gradient and cascading, with occasional low gradient benches. The lower reach is a beaver influenced area; near the confluence with the Blackfoot River, Arrastra Creek slows in a series of beaver ponds. The upper-half of the

drainage is managed by Helena National Forest, while the lower-half is privately owned. Recent harvest of timber occurs on some sections of private land. A 50-foot culvert with a three foot drop exists at a crossing for Forest Service Road in the upper drainage. Cutthroat trout and a bull trout were sampled below the culvert in 1996, but no fish were sampled immediately above it in 1989, indicating the culvert is a barrier to upstream movement. Modifying the culvert to allow access to the low-gradient benches upstream would provide spawning sites not otherwise abundant to fish in this section of stream.

Fish populations in Arrastra Creek were sampled in four sections in 1989; those results are presented in Peters (1990). In 1996, two of these sections (RM's 0.5 and 2.3) were sampled again, revealing large differences in the species composition and abundance. While only brown trout were sampled at RM 0.5 in 1989, brown trout, cutthroat trout and brook trout were present in 1996 (Appendix, Exhibit A). Similarly, while brook trout and brown trout were sampled at RM 2.3 in 1989, bull trout and cutthroat trout, in addition to brook trout and brown trout, were sampled in 1996. Brook trout and brown trout were the most abundant trout in both years. YOY comprised the majority of the catch for both of these species in 1996, indicating this section of stream is used for spawning.

Douglas Creek

Douglas Creek, a basin-fed, third-order stream, originates in Powell County on properties of mixed ownership. From its headwaters, it flows easterly through BLM, Plum Creek Timber Company land and two small, privately owned reservoirs in the lower third of the drainage. It enters Nevada Creek at RM 4.4. Mid- to lower sections of Douglas Creek are degraded (Figure 55).

Fish were surveyed at three locations, RM's 0.2, 8.0 and 15.3, in August 1994. A CPUE of 10.3 cutthroat trout was found at RM 15.3; the stream was impacted by high amounts of sediment at this location. At RM 8.8 the stream appeared to have low flow, high amounts of sediment and excessive levels of nutrients. Longnose dace, redside shiner and largescale sucker, but no salmonids, were sampled at this location. No fish were captured at RM 0.2.

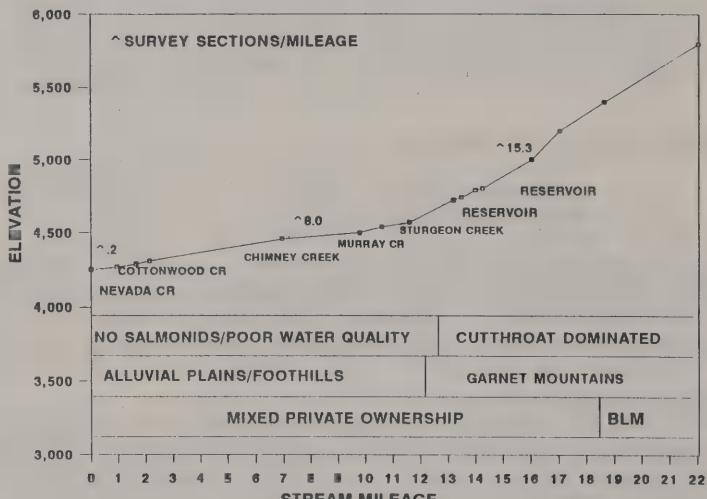


Figure 55. Douglas Creek Longitudinal Profile.

East Twin Creek

East Twin Creek flows southerly from its origin in Lolo National Forest in Missoula County to its confluence with the Blackfoot River at RM 10.8. It is a basin-fed, second-order stream with lower reaches influenced by encroachment from the Gold Creek Road and a large culvert at RM 0.2 which has impeded the movement of fish since the 1970's (FWP, unpublished data). East Twin generally supports low numbers of rainbow trout, brown trout, cutthroat trout and brook trout.

Finley Creek

Finley Creek is a small tributary to Placid Creek located in the

Clearwater River drainage. It originates in a low relief drainage in a section of forest dominated by commercial timber harvest. The lower section of the stream flows through pasture lands where heavy grazing has severely damaged stream banks. Fish were sampled at RM 1.9 in Finley Creek. At this location low numbers of cutthroat trout and brook trout were collected. CPUE was 3.6 and 2.2 for these two species, respectively. Sculpins were recorded as common in the sample.

Frazier Creek

Frazier Creek, a small, basin-fed third-order stream, originates in the Garnet Mountain Range, and flows westerly, entering the Blackfoot River at RM 59.4. This stream flows through two small reservoirs used for irrigation. In lower reaches, the stream channel is severely damaged, preventing fish passage. Leary (1994) reported a pure population of westslope cutthroat trout in this stream. Although not comparable to CPUE in streams, a 1994 survey of the upper reservoir had a CPUE of 40 fish per hour.

Hogum Creek

Hogum Creek is a small tributary to the upper Blackfoot River that drains from the Garnet Mountains and enters the mainstream at RM 119. After flowing through a steeply forested drainage, it enters a willow wetland heavily influenced by beaver. A survey near the mouth recorded a cutthroat dominated fishery with CPUE 7.4, brook trout with CPUE 5.6 and mountain whitefish CPUE 0.9.

Humbug Creek

Humbug Creek is a small tributary to Poorman Creek located on the south side of the Lincoln Valley. The stream flows northwest for 3 miles from mountainous terrain through low relief glacial topography. The system is influenced by beaver wetlands and land use practices including farming, grazing practices and irrigation in the lower basin. Sections of the lower channel have been plowed and are essentially nonexistent in the downstream-most portion of the drainage. In July 1995, a 500 foot section was sampled at RM 1.7. The survey recorded cutthroat trout and longnosed dace, with CPUE's of 13.8 and 0.2, respectively.

Lincoln Spring Creek

Lincoln Spring Creek is a large spring creek flowing through the town of Lincoln. This stream provides a significant percentage of the upper Blackfoot River flows during low flow periods. This spring creek is negatively affected by residential development (including septic wastes), loss of instream woody structure, and stream crossings. According to local accounts, it historically contained bull trout and cutthroat trout, but none have been recorded in the 1995 sampling effort. Population surveys were made at three locations, RM's 1.4, 2.1 and 2.4, in July 1995. For a spring creek environment, densities of brown trout ≥ 4.0 in. were low at all locations with estimated densities of 4.2 to 8.9 fish/100 ft. Brook trout and sculpins were recorded in the sample.

Lodgepole Creek

Lodgepole Creek is the primary tributary to Dunham Creek. Although it appears unimpaired, the fishery is probably indirectly affected by degraded conditions and intermittent sections in Dunham Creek that prevent fish from accessing the stream. A 540 foot section of lower Lodgepole Creek, RM 0.4, was sampled, revealing a native fish community of cutthroat trout and bull trout. Eighty-one percent of the catch consisted of cutthroat and 19% bull trout, 4.1 and 0.9 CPUE, respectively. One mature, fluvial bull trout (20 in

TL) was captured, but no YOY. This stream is one of the few in the Blackfoot River drainage with a native fish assemblage that includes bull trout, sculpins and tailed frogs. A natural barrier to upstream movement exists at RM 0.75; limited spawning habitat for bull trout exists below this point. No redds were found during a survey on September 16, 1996.

McCabe Creek

McCabe Creek is a small, second-order tributary to Dick Creek (Appendix A). It flows westerly from a catchment basin on Spread Mountain in Lolo National Forest, joining Dick Creek at RM 3.8. This stream supports good numbers of cutthroat trout, including juveniles, and low numbers of brook trout. It is affected by dewatering, losses of fish to irrigation ditches and a fish migration barrier at the county road crossing located at RM 2.5.

In 1992, fish population surveys were taken above and below the culvert. Fish densities were recorded at 23.2 fish/100 ft above the culvert compared to 64.9 fish/100 ft below the culvert. The surveys included recording higher numbers larger cutthroat trout below than above the culvert. A small ditch, located at RM 2.2, was sampled and cutthroat trout captured with a CPUE of 4.0/100 ft.

Murray Creek

Murray Creek is a second-order stream, joining middle Douglas Creek at RM 10.6. This basin-fed stream flows through checkerboard land ownership including Plum Creek Timber Company, BLM and State Trust. The lower third is privately owned. In August 1994, a single-pass survey at RM 3.0 recorded cutthroat trout with CPUE of 9.3 and sculpins. This sample occurred in a reach impacted by grazing and seasonal barriers to fish movement at road crossings.

Morrell Creek

Morrell Creek is a large stream that drains from the west side of the Swan Range, joining the Clearwater River at RM 18.3. Two fishery samples were taken at RMs 0.1 and 4.3. Brook trout, brown trout and bull trout were present in the lower section with a CPUE's of 6.9, 7.5 and 0.3. The bull trout in this sample were probably adfluvial, rearing in Morrell Creek before emigrating to Salmon Lake. At RM 4.3, the abundance of cutthroat trout and bull trout increased, CPUE 6.3 and 6.0 respectively, while abundance of brook trout decreased to a CPUE of 1.7. Sculpins were reported in both sections with densities common and abundant in the upstream and downstream samples, respectively. One bull trout redd was observed at RM 0.5 during a survey conducted September 20, 1996.

Owl Creek

Owl Creek, the outlet stream of Placid Lake, is a major tributary to the lower Clearwater River. It flows east 4.3 miles to its junction with the Clearwater River at RM 15.6. The stream is influenced by a water control structure at the lake outlet that is a fish passage barrier. Owl Creek was possibly the site of log drives, as little wood exists in the channel and habitat is generally simple riffles. Fish surveys were conducted in three section of Owl Creek in August 1990 at RM's 1.2, 2.4 and 4.2. Brown trout, rainbow trout, mountain whitefish, largescale sucker, northern squawfish, redside shiner and longnose dace were sampled. The downstream section had the highest species diversity of all sections. Densities of brown trout (CPUE 1.2 to 6.5) and rainbow trout (CPUE 0.8 to 1.5) were low for a stream the size of Owl Creek.

Spring Creek

Spring Creek is a primary tributary to upper Cottonwood Creek, entering

at RM 11.9. This stream has fish passage problems and has recently been diverted from its historical channel. The Blackfoot tributary inventory work (Peters 1990) incorrectly recorded Spring Creek as a Cottonwood Creek section at RM 12.4. This 1989 sample recorded a cutthroat trout dominated fishery with CPUE of 8.3, with lower numbers of bull trout (CPUE 0.7) and brook trout (CPUE 0.2); sculpins were present in the sample (Peters 1990). At the time of the 1989 survey, the stream had just been diverted. Bull trout in the sample were believed to originate from the Cottonwood Creek population.

Spring Creek (2)

This is a small meadow spring creek that is a tributary to Placid Creek. Streamside grazing has damaged streambanks in places. A fishery survey at RM 0.2 recorded cutthroat trout with a CPUE 2.1 and sculpins as the two fish species present in this stream.

Wasson Creek

Wasson Creek is a small basin-fed Garnet Mountain stream and tributary to upper Nevada Spring Creek. Land uses in the drainage includes grazing, timber harvest and irrigated hay production. The fishery is impaired in places by streamside grazing and dewatering; barriers to fish passage occur in lower reaches. Wasson Creek contains cutthroat trout, with low numbers of brown trout present in lower reaches. In August 1991, five surveys of fish population were completed in the lower three miles of channel. CPUE for cutthroat trout declined in the downstream direction from 26.7 at RM 3.0 to 0.5 at RM 0.9, but increased to 0.8 at the confluence. A low density of brown trout was recorded in the lower 0.6 miles of stream.

Willow Creek

Willow Creek is a small tributary to the upper Blackfoot River. The stream originates in the Dalton Mountain area of the Garnet Mountains, flows north 9 miles through forest and agricultural bottom lands before discharging into the Blackfoot River at RM 102.5. The lower reach of stream is impaired from riparian management practices, instream structures (including undersized culverts). The fishery was sampled at RM's 1.7 and 5.6. Cutthroat trout were the most abundant fish in the upper section with a CPUE 18.0, followed by brook trout with a CPUE of 9.0. At RM 1.7, low numbers of brown trout (CPUE 2.0) were recorded in the sample.

Yourname Creek

Yourname Creek, a small stream originating in the Garnet Mountains, and flows north 4.5 miles to its confluence with the Blackfoot River at RM 65.3. Land uses in the drainage include timber harvest, livestock grazing and hay production. Water is used for irrigation and livestock watering. At least one major irrigation diversion utilizes water from Yourname Creek, entrains cutthroat in the irrigation system. Riparian grazing impacts the lower riparian area in places. In August 1992, a population survey at RM 1.8 showed high densities of YOY cutthroat trout with a CPUE 13.1 and age 1 plus fish with CPUE 18.1. Yourname Creek has potential as a source of cutthroat trout recruitment to the Blackfoot River.

EXECUTIVE SUMMARY

Blackfoot River Fishery

Lower segments of most tributaries in the Blackfoot drainage contain populations of brown trout. Downriver of Nevada Creek, the lower segments of most tributaries also support populations of rainbow trout, particularly

younger age classes. From 1990 to 1996, fishery inventories were completed on an additional 33 tributaries to the Blackfoot River, five of which were located in the Clearwater River drainage. Of the 52 streams sampled since 1988, bull trout were present in 13 and westslope cutthroat trout present in 46. No new populations of bull trout have been identified since 1989. The legal harvest of bull trout and cutthroat trout was eliminated with the adoption of catch-and-release regulations in March 1990. Regulations for rainbow trout and brown trout also changed, shifting from the taking of five fish to three fish under 12 in. These regulations were designed to increase survival of spawning size fish to enhance reproduction and recruitment.

We observed a significant decline in the estimated densities of rainbow and brown trout in the Blackfoot River from 1993 to 1996 in monitoring sections near Johnsrud Park and the Scotty Brown Bridge. The declines appeared most severe on the smaller size classes (4.0 to 12.0 in. TL). Estimated densities of larger brown and rainbow trout had increased 200 to 500 percent from 1990 to 1993 in the Scotty Brown Bridge and Johnsrud sections. Johnsrud rainbows trout \geq 12.0 in. TL declined to 1990 levels in 1996. The Scotty Brown bridge rainbows $>$ 14.0 in. TL declined from the high densities in 1993 of 15.7 fish/1000 ft. to 10.6 in 1996.

The cause of significant declines in rainbow and brown trout numbers in 1996 may be related to the "ice flows" of February 1996. Both species rely almost exclusively on the Blackfoot River's near shore zones for rearing of juveniles. This zone was severely impacted by the "ice flow" that scoured stream substrates and removed near shore willow cover. The near shore willow cover provides critical resting habitat during high flow periods. Resting habitat appears to be limited during high flows in the confined Blackfoot River channel based upon electrofishing catch and high success in these areas during peak flows. Doyle et al (1993) witnessed severe channel disturbance in British Columbia and documented fish losses as a result of river ice break-up. Other potential causes of population decline in 1996 could be low stream flows from 1992 to 1995. Angling is not a likely cause, mainly because the impacts affect the small size groups not normally associated with angler impacts. Whirling disease is also not suspected as it has not been detected in the Blackfoot River samples yet.

Blackfoot River Special Fishing Regulations of 1990

The Blackfoot River was the first western Montana stream to include the use of natural bait in a special regulation water. A Blackfoot River user survey conducted during the regular fishing season in 1994 found that 30% of the anglers were natural bait anglers (Peters 1996). The purpose of the special regulations were to re-establish healthy numbers and age structures of native and non-native fish. Decreasing angler harvest of larger fish, along with improving recruitment in middle and upper reaches of the Blackfoot River were our primary means to attain recovery of fish populations.

Increased rainbow, brown, and cutthroat trout populations through 1993 in the Scotty Brown and Johnsrud monitoring sections give evidence that including natural bait anglers in special regulation waters can work. Some factors that may have assisted in this apparent success include: 1) large size of special regulation water (entire drainage), 2) special enforcement efforts, 3) better than normal signing of regulations, 4) relatively low angling pressure compared to other Montana streams, and 5) increased news media coverage about Blackfoot River problems has heightened awareness among anglers. The relatively high mortality of natural bait caught and released fish, reported in the literature, can be greatly reduced by the natural bait angler through one technique change: Do not let the fish swallow the bait. This can be accomplished by setting the hook immediately upon feeling a strike, by not "soaking" baits in pools, and by holding onto the fishing pole at all times while fishing. Many long-time natural bait anglers already use these techniques. They may be part of the reason for these initial successes.

In the lower reaches of the Blackfoot angling pressure is approximately 800 to 1000 angler days per mile per year. It is unknown when catch and release mortality will become significant enough to reverse the positive fish

population trends already observed.

Blackfoot River Restoration

The Blackfoot River drainage in west-central Montana is the site of a major river basin restoration effort. The effort began in 1988 with the initiation of studies to identify the reasons for declining stocks of sportfish perceived by anglers. The study efforts identified two major aquatic resource problems in the drainage: 1) toxic mining wastes entering the headwaters and 2) degraded tributary streams. The headwaters toxic mine waste clean-up is being managed through DEQ, State Super Fund statutes and the "Volunteer Actions" of the responsible parties.

The resource problems associated with the degraded tributaries are being addressed through landowner-agency cooperative efforts. From 1990 to 1996, restoration of stream habitat and water quality, wetlands and rangelands in the Blackfoot River drainage has occurred. Most effort has focused largely on improving riparian management of tributaries to the middle reaches of the Blackfoot River. Fishery restoration projects have been completed, or are progressing, in 23 streams. These projects have included removing barriers to fish migration, restoring and enhancing trout habitat, protecting critical spawning habitat, enhancing riparian vegetation, wetlands and instream flows; developing low impact riparian grazing strategies, removing streamside feedlots and developing areas for off-stream livestock watering (Appendix, Exhibit D)

The distribution of native fish in the Blackfoot River extends from extreme headwaters to large river reaches. The environment in which native fish evolved is varied: streams originate in alpine tundra, flow through subalpine forest and montane woodlands, and finally enter a semiarid, glacially modified environment before joining the Blackfoot River. Fish evolved with drought, underfit and intermittent stream channels and beaver activity. The co-evolution of fish and a highly variable physical habitat, resulted in complex movement patterns, specific spawning and rearing behavior. These fish further evolved with high quality habitat which included complex pools, lower sediment levels and cooler stream temperatures than are currently found in many tributary systems. Bull trout and cutthroat trout tend to reproduce higher in the tributaries and rear for longer time periods in upper stream reaches before migrating to the mainstem environment than rainbow or brown trout. While this behavior may insolate sensitive early life stages from environmental extremes in the mainstem system, reproduction and rearing higher in the drainage also increase vulnerability of native fish to human-caused alterations of tributary ecosystems such as habitat degradation, impaired fish passage and fish losses to irrigation canals.

Widespread degradation of tributaries to the Blackfoot River has occurred. This degradation has negatively affected fish, particularly native fluvial trout, which spawn only in tributaries and require a connected river system to maintain their life-history. The conservation of native fish in the Blackfoot River drainage requires the recovery of stream habitat and system connectivity. With these requirements in mind, efforts to restore fisheries have been completed, or are progressing, in 23 tributaries. Improvements to fish habitat, wetlands, or rangelands have been made in 16 of these streams. Connectivity in the drainage has been improved by removing migration barriers, increasing instream flows, and screening irrigation ditches on 20 streams. To date, over 200 miles of tributary waters been affected by these efforts. While projects are generally designed to target all life-history stages of native fish, other species may also benefit. From 1989 to 1996, the abundance of westslope cutthroat trout over 12 in. has increased in the middle reaches of the mainstem Blackfoot River.

The abundance of bull trout is increasing in some core watersheds that have received restoration activities. Habitat or fish passage projects have been completed, or are progressing, on five of seven core watersheds, influencing approximately 80 miles of fluvial bull trout and cutthroat trout habitat. Fish passage barriers were removed in nine additional major tributaries where bull trout and/or westslope cutthroat trout historically

spawned, improving connectivity to approximately 60 additional river miles. Combinations of instream habitat enhancement, and riparian and upland management measures are beginning to reduce levels of sediment and temperature, impacts that are considered deleterious to native fish.

Bull trout conservation requires the protection and/or improvement of nodal habitat in the mainstem Blackfoot River. The mainstem Blackfoot River provides importance wintering and cold thermal refuges when streams and rivers warm. Areas of thermal refuge include confluence areas of cold streams, even though these stream may not currently support bull trout. Watershed restoration can help reduce stream temperatures and help provide thermal refuge.

The distribution of rainbow trout and brown trout in the drainage is limited to the mainstem and lower portions of tributaries. In the lower half of the Blackfoot River, reproduction and rearing of these fish occurs in lower reaches of tributaries. Although densities of rainbow and brown trout YOY have improved in several key spawning areas, densities of juvenile fish in the mainstem remain lower than expected. This indicates high mortality of juveniles upon entering the mainstem Blackfoot River. Improved rearing conditions in tributaries could improve the resiliency of the lower to mid river fishery; recruitment of a larger juvenile fish better able to withstand the river environment would facilitate recovery of mainstem populations following drought or other disturbances. Several tributaries that have received restoration are, in fact, beginning to support larger densities of age 1 plus juvenile rainbow and brown trout.

The recently confirmed presence of *Myxobolus cerebralis*, an exotic parasite, has introduced whirling disease into waters of the Blackfoot River basin (Appendix, Exhibit K). This parasite attacks fish in the first year of life. Its life-cycle is dependant on the presence of *Tubifex tubifex*, a small aquatic worm. Pristine headwater streams appear to make very poor *Tubifex* habitat. Higher densities of *Tubifex* worms typically occur in streams that are organically enriched or influenced by reservoir release. Other areas likely to have *Tubifex* are spring creeks and almost any other stream or river impacted by urban, agricultural or forestry practices. Dr. Dan Gustafson, MSU, has collected several insect samples from various locations within the Blackfoot River drainage in the spring of 1996 to identify locations with *Tubifex*.

Restoration techniques such as removing riparian feedlots, improving riparian grazing systems, and using forestry BMP's may help moderate the effects of whirling disease on fish that reproduce in lower tributaries. Restoration activities have occurred in ten headwater streams. Improved spawning and rearing conditions in these cold, basin-fed streams, which are thought to be above the range of *Tubifex*, should reduce impacts this disease has on river populations.

Additional tools used to benefit fisheries include conservation easements, wetland restoration, improved grazing systems and offstream livestock watering efforts. While the health of many riparian areas and stream habitats have improved, much work has yet to be completed. To date, none of the 23 project streams have been completely restored although many are approaching final restoration phases. These 23 project streams represent approximately 50% of the streams identified as impaired.

Factors Contributing to Successes of Restoration Projects

Several factors contribute to successful restoration projects. An important first step in the Blackfoot Basin is public recognition that fishery resources have declined basin-wide. Secondly land managers generally have a good conservation ethic. Thirdly, mutual trust is critical for successful restoration; working one-to-one with landowners develops mutual trust, and thereby helps form long-term working relationships. Finally, all restoration participants share a common vision of working cooperatively with private landowners combined.

The long-term goal of Blackfoot River Restoration Project has evolved from the restoration of degraded streams to restoration of major components of

the ecosystem focusing on private lands while using a multi-disciplinary resource approach. Management of uplands, wetlands, and riparian areas not sensitive to the long-term health of fish and wildlife resources are also being addressed through cooperative projects. The successes of individual projects are important, but even more important is our willingness to work with landowners to incorporate land management practices more sensitive to overall ecosystem health.

Bull trout

Status

The Fish and Wildlife Service announced on March 13, 1997 that two populations of bull trout, the Columbia River basin and the Klamath River basin, warranted listing under the Endangered Species Act. The FWS has indicated that an official notification to list bull trout will occur June 13, 1997. This action will invoke additional data collection and public involvement before a final ruling on the listing occurs in one year.

In Montana, bull trout are classified as a "Species of Special Concern" by FWP. Habitat degradation, small populations, hybridization with brook trout, and over harvest have contributed to this classification (Thomas 1992). In the Blackfoot River drainage, mining and introduced fish species are rated as the two predominant risks facing bull trout (Montana Bull Trout Scientific Group 1996). Forest practices, livestock grazing, and residential development also have impacted habitat. Milltown Dam, located at the confluence of the Blackfoot and Clark Fork rivers, and irrigation diversions further impact bull trout by directly removing fish from the population. Swanberg (1996) documented two radio-tagged bull trout entering irrigation canals and three moving out of the Blackfoot River and downstream of Milltown Dam (8% of the sample).

The Blackfoot River supports one of the better populations of fluvial bull trout in the range of the species. An evaluation of populations in the Clark Fork River drainage upstream of Flathead River indicated the Blackfoot River had the highest densities of this life-history form (Peters 1985); nevertheless, redd counts, population surveys and observations of anglers in the drainage indicated the size of the population was declining (Peters 1985, 1989). In 1989, only 3 of 19 sampled tributaries had densities of YOY greater than one fish/100 feet (Peters 1990). Furthermore, the lack of YOY in streams historically used for spawning indicated some populations were extirpated. Of 52 streams sampled from 1989 to 1996, 12 (including one tributary to the Clearwater River) had bull trout. Of the 11 streams with fluvial bull trout joining the mainstem Blackfoot River, all were core streams or streams in which bull trout were identified in the 1989 study.

Copper Creek, a tributary to the Landers Fork of the Blackfoot River, the North Fork Blackfoot River and Monture Creek contain the three largest populations of juvenile fluvial bull trout in the drainage. Large portions of each of these drainages are in designated wilderness and/or roadless areas. Of the seven identified core watersheds, Copper Creek is the only one with a drainage-wide native fish assemblage.

Excluding the Clearwater River drainage, fluvial bull trout currently occur in 10 sub-watersheds in the Blackfoot River drainage, and, based on historical records, are extirpated from 11 drainages or approximately 120 miles of stream. Fluvial bull trout currently use approximately 420 river miles in the drainage, including 120 miles of mainstem river and 300 miles of tributaries. Spawning occurs in approximately 24 of these 300 stream miles (8%).

Since 1990, 8 of the 12 streams with fluvial bull trout have received special land, water and fish management considerations. Efforts to recover bull trout populations have occurred in five of the seven core drainages, as well as in several streams historically supporting bull trout. Protection and enhancement of tributary habitat, restrictive angling regulations and recovery from drought conditions have increased the number of spawning bull trout in two of these streams. Over an eight-year period since 1988, redd counts have

increased from 10 to 65 in Monture Creek and from 7 to 59 in the North Fork of the Blackfoot River. From 1989 to 1994, CPUE of juvenile bull trout in Monture Creek and the North Fork of the Blackfoot River has also increased from 0.7 to 1.6 (229%) and from 1.7 to 2.9 (171%) fish/100 ft, respectively.

Long-term monitoring of fish populations in the Blackfoot River indicate stable to increasing densities of bull trout in the middle reaches of the Blackfoot River and the lower North Fork of the Blackfoot River, but a recent decline in the lower Blackfoot River. From 1990 to 1991 in the Johnsrud section, estimated densities of bull trout ≥ 6.0 in increased from 1.4 to 4.2 fish/1000 ft. The 1993 survey recorded a slight decline in numbers. The 1996 survey identified a decline to densities 35% of the 1993 densities; (2.3 fish/1000 ft in 1993 compared to 0.8 fish/1000 ft in 1996). Factors that may have contributed to this result include: 1) mortality or movement of bull trout downstream of Milltown dam as a result of the February 1996 "ice-flow", 2) lingering drought losses including excessive temperatures in the Blackfoot River in 1994.

In the Scotty Brown section of the middle Blackfoot River, densities of bull trout ≥ 6.0 in increased 57% from 1.5 to 2.6 fish/1000 ft between 1990 and 1996. In the North Fork Blackfoot River, densities of bull trout ≥ 12.0 in appear to be following the same trend, with densities increasing from 0.8 to 1.6 fish/1000 ft from 1998 to 1996.

In 1996, a total of 198 redds were recorded in a drainage-wide survey. Seventy percent of these redds were recorded in Monture Creek and the North Fork of the Blackfoot River. While data indicate populations of bull trout are increasing in these two streams, populations of bull trout are very small in other tributaries; several tributaries may have lost their populations in recent years. In general, the status of bull trout in the Blackfoot River drainage remains precarious.

Life history

Three life-history forms of bull trout exist in the Blackfoot River drainage. Fluvial, or river-dwelling, bull trout are the most common life-history, using the mainstem Blackfoot River and some connected tributaries. Adfluvial, or lake-dwelling, bull trout inhabit the Clearwater River drainage and Coopers Lake. This report does not address the Clearwater populations; their abundance and distribution is currently being studied (R. Berg, FWP, unpublished data). A resident population of bull trout occurs in upper Cottonwood Creek; historically this population was probably fluvial.

Fluvial bull trout in the Blackfoot River have specific habitat requirements that include large, connected river systems, complex pools associated with boulders and/or woody debris, areas of cold-water refuge, and low levels of fine sediment in spawning substrates. These fish spawn in some second- to third-order tributaries to the Blackfoot River, mostly in areas influenced by groundwater upwelling. Fry emerge from gravels in early spring and move passively to stream margins and side channels where they rear. In some streams (e.g., Monture Creek), this rearing habitat exists near incubation sites; however, in other streams these life-history stages may be separated by many miles (e.g., North Fork of the Blackfoot River). After rearing for three to four years, fish emigrate to the Blackfoot River. It appears that upon entering the Blackfoot River these fish move downstream to suitable over-wintering habitat and remain there for several years before maturing.

Mature bull trout begin migrations to their natal tributaries in late spring to early summer, when run-off has peaked and water temperatures begin to warm. Depending on the timing of run-off, bull trout may enter tributaries as early as the first week of June. Most bull trout entering tributaries do not spawn, but instead hold in lower portions of the stream before returning to the Blackfoot River less than a month later. Those fish that do spawn will begin to do so in September, after having spent over two months in the tributary. Almost all migrants return downriver to the same sites they had occupied prior to migration.

Blackfoot River Nodal Habitat

The Blackfoot River serves as nodal habitat in the drainage. Although not vital for spawning and rearing bull trout, this habitat is important for over-wintering adults, maturing juveniles and migrating adults. From 1994 to 1996, 53 radio-tagged bull trout were tracked in the Blackfoot River. The majority of these fish were adults, and migrated to tributaries during summer months. This seasonal use of tributaries allowed these fish to avoid encountering warm ($>70^{\circ}\text{F}$) temperatures common in the river in low-flow years. During winter months in the mainstem Blackfoot River, these fish moved less than 200 yards and typically remained within a habitat unit. Individual use of habitat types varied: some fish used deep pools, while others were found in boulder riffles. Other radio-tagged bull trout, particularly smaller, immature fish, remained in the river throughout the year. These fish were occasionally subjected to warm temperatures. For example, during the warm, low-flow summer of 1994, two immature bull trout were continuously located in a confluence with a cold tributary. This behavior allowed these fish to avoid warm river temperatures.

In summary, the use of the Blackfoot River by fluvial bull trout is dependent on life-history stage. Adults use river habitat during winter. Pre-spawning fish stage in tributaries near spawning areas during summer. Migrating, but non-spawning fish similarly use the Blackfoot River during winter, but use separate habitat in tributaries during summer. Non-migrating, maturing bull trout continually use river habitat. Finally, juvenile bull trout rear in tributaries in locations that may be separate from spawning sites.

Influence of Water Temperature on Bull Trout

Water temperature is thought to greatly influence the distribution of bull trout (Rieman and McIntyre 1993). In the Blackfoot River drainage, the location of spawning sites is closely tied to the presence of groundwater upwelling. Groundwater provides a stable thermal regime that is warmer than ambient water temperatures in winter, but colder in summer. This regime is critical to the development of eggs, which may freeze in ambient temperatures. Temperatures in spawning areas during the incubation period (September to March) are stable, fluctuating from 36 to 40°F. In contrast, downstream reaches not influenced by groundwater may form anchor ice and water temperatures may drop below 32°F. This affinity for upwelling areas for spawning and incubation greatly limits the amount of available spawning habitat. While maturing in the Blackfoot River, bull trout may encounter summer temperatures greater than 70°F. Sexually mature bull trout migrate to tributaries as water temperatures increase in the early summer. Although some of these fish migrate to spawn, it is possible many enter tributaries to escape warm summer temperatures. Instead of migrating to cooler tributaries, smaller, immature fish remain in the Blackfoot River and may avoid warm water by using confluences with small, cold tributaries. This behavior is suitably reflected in the bull trout's scientific name (*S. confluentus*).

Water temperatures that exceed the bull trout's preferred range may cause high mortality rates. The crowding of bull trout in thermal refuges could expose the fish to added competition, stress, predation, and illegal harvest. Reiman and McIntyre (1993) felt bull trout distribution was limited by 59°F water temperatures. Daily maximum temperatures in the Blackfoot River exceeded 60°F at all 5 monitoring stations annually from 1994 through 1996. The worst exceedences occurred at Raymond bridge, Scotty Brown bridge and Wisherd bridge, respectively exceeding 60°F 98, 91, and 86 days between 1994 and 1996.

Swanberg (1996) suggested that long migrations of non-spawning bull trout to tributaries, possibly to seek thermal refuge, may be an adaptive response. If the movement can be linked to adaptive behavior it may also indicate the river temperature problem is not just a recent phenomenon. Elle (1995) also observed the migration of non-spawning bull trout into a spawning stream during spring spawning runs in the Salmon River system of Idaho. Warm

water temperature in the Salmon River was also a possible motivation for early summer movement.

Use of cold-water confluences has important management implications. Firstly, these cold water zones provide "thermal refuges" which slows metabolism and allows fish to conserve energy. Secondly, because streams creating these thermal refuges may be small and not contain bull trout, their importance as providers of nodal habitat in the Blackfoot River may be overlooked by land managers. Although warming of water temperatures in small tributaries may not have a great overall affect on ambient temperatures in the main river, the loss of a thermal refuge will have negative consequences for bull trout. The identification and conservation of these areas will provide critical thermal refuge for bull trout.

In the Blackfoot River drainage wide-spread canopy removal, alterations to streamside vegetation, and warm-water irrigation returns have altered the historical temperature regime. These alterations may be more critical to the persistence of bull trout in drainages where biological signs of historic temperature "bottlenecks", such as fish migrating to cooler environment already occur.

Sediment Conditions in Tributaries

The Blackfoot River is a sediment rich system. Glacial landforms from recent glacial events and a geologically "fresh" landforms contribute to significant erosional features along stream channels throughout the basin. The interaction of channel types, stream bank vegetation, and peak hydrograph events provide the sorting and cleaning of stream bottom substrates necessary for salmonid fish habitat to flourish in the Blackfoot River system. Bull trout have been characterized as a fish species sensitive to high sediment levels in spawning and rearing streams.

The percentage of fine sediment in McNeil core samples has been correlated with the percentage of surviving bull trout fry at the time of emergence (Weaver and White 1985). The percentage of fine sediment near bull trout redds in Monture Creek averaged 29.3% (range 9.9 to 40.8%, N = 10), correlating to a 34% survival rate (Kramer and Walker 1993). This percentage of fine sediment is high, but represents "natural" sediment levels in spawning riffles of Monture Creek.

In the North Fork of the Blackfoot River mean percentage of fines was 25.7% in 1992 (Kramer and Walker 1992). This correlates to a 39% survival rate for bull trout fry at emergence (Weaver and White 1985). Interestingly, significant erosional events throughout this drainage occurred following the Canyon Creek Fire of 1988 that cleared most of the vegetation in the drainage.

Naturally high levels of sediment in Monture Creek and the North Fork have significant implications for bull trout recovery plans in the Blackfoot River. Generally, the drainage's naturally high levels of sediment reduces flexibility of land managers to contribute sediment to the system. In the case of Monture Creek and other streams that have sediment levels near the tolerance limit of bull trout, additional human-caused sedimentation should be closely evaluated prior to generating new sediment sources. Land managers must understand that a river already carrying a full load of sediment requires land uses to be done carefully.

A good example of a land manager responding to a sedimentation problem occurred in Belmont Creek. No core sampling occurred in this stream; however stream bottom fines appeared to be extremely high based upon visual observations. The major landowner in the drainage, Plum Creek Timber Company, has evaluated sediment problems in the drainage. As a result, they have taken several actions regarding their management options to positively address sediment sources in the drainage including improving road drainage, closing roads when roadbeds are wet, improving and monitoring grazing management.

Recovery Goals

A bull trout recovery plan for the Blackfoot River has not yet been prepared. However several key components of a bull trout recovery plan are

already in place including: 1) identifying critical habitats, 2) protecting and enhancing of those habitats, 3) encouraging citizen and share-holder participation in recovery efforts, 4) active monitoring of bull trout status, 5) establishing programs for long-term maintenance of critical habitats, 6) developing mechanisms for funding of needed habitat restoration, 7) dedicating agency personnel to efforts needed for recovery of critical habitats, 8) evaluating and expanding our knowledge of the physical and biological factors limiting bull trout recovery.

The fisheries division of the FWP has committed funding for the hiring of a draft recovery plan writer/researcher in 1997. Key to the restoration goals developed for the Blackfoot River will be the maintenance of self-reproducing, migratory life-history forms, with spawning distributed among core drainages. Current goals of the Blackfoot River bull trout restoration efforts are to: 1) maintain and enhance populations in all tributaries where they presently exist; 2) restore habitats and monitor fish populations in tributaries where they historically existed and where improved water quality could improve overall bull trout habitat in adjoining systems; and 3) maintain or increase connectivity in the drainage, as well as restore connectivity between the Blackfoot and Clark Fork rivers. The draft recovery plan will need to address risks to bull trout recovery in all the core/nodal areas and develop the means to attain resolution of the risk potential.

In 1996, 198 bull trout redds were counted in all the core watersheds of the Blackfoot. This number is double an arbitrary preliminary recovery goal of 100 (Montana Bull Trout Scientific Group 1995). The geographical distribution of core drainages and numbers of spawning fish within each of the core drainages was not addressed by the committee. The geographical distribution of the core drainages may be of equal importance to the long-term viability of bull trout in the Blackfoot River. The close geographic proximity of Mointure and the North Fork of the Blackfoot could expose them both to the same "environmental disturbances" (Reiman and McIntyre 1993), with potential loss of a significant portion of the Blackfoot River bull trout. In 1996, 69% of the basin-wide spawning occurred in these two streams, and 85% of the spawning in the drainage occurred from the North Fork of the Blackfoot downstream.

A bull trout management objective, stated in the 1990 Montana Fish, Wildlife and Parks Blackfoot River Management Plan (Peters 1990) was to increase the standing crop of adult bull trout larger than five pounds to 1 fish/1000 ft. This goal has not been met and, similar to the committee's goal, is too simplistic to adequately address the diversity of bull trout life-history in the Blackfoot River. This diversity requires that restoration of bull trout populations to be addressed holistically. Examples of this holistic approach include: 1) protecting spawning habitat is effective only if unscreened irrigation downstream of spawning areas are screened (unscreened canals can entrain fish); 2) restoring physical habitat in tributaries is most valuable when migration corridors to the area exist or can be restored; 3) water temperatures in the Blackfoot River, which exceed the bull trout's preferred range, can be most improved by addressing impacts to streams not likely to contain bull trout, but that contribute warm temperatures to the Blackfoot River (e.g. Nevada Creek).

A more comprehensive set of recovery goals needs to be developed that incorporates: 1) local knowledge of the bull trout biology in the Blackfoot River and population viability and metapopulation concepts (Reiman and McIntyre 1993), 2) continued angler education programs, especially for fish identification (Galda, Long and Rahmlow 1995), 3) a scientific evaluation of the need and feasibility to remove brook trout populations in core watersheds, and 4) a means for acquiring independent and professional multi-disciplinary evaluations of potential major developments in the drainage that could threaten bull trout. Other factors also need to be included in the goals and risks assessments, such as core drainages, and the connecting river segments between core drainages, numbers of spawners in each core area, over-wintering areas, migration routes, Blackfoot River water quality and habitat conditions and temporary refuge areas.

Westslope Cutthroat Trout

Status

Like the bull trout, westslope cutthroat trout has been identified as a "Species of Special Concern" in Montana. Populations of this fish were once widespread throughout western Montana (Van Eimeren 1996). Today, westslope cutthroat trout are the dominant species in most headwater areas of tributaries to the Blackfoot River (Peters 1990). Of 52 tributaries sampled since 1989, all but four have the recorded presence of cutthroat trout. The four streams where cutthroat trout were absent were spring creek environments dominated by brown trout fisheries. Westslope cutthroat trout typically decline in abundance in lower reaches of tributaries and are replaced by non-native rainbow trout and brown trout. In many streams, this segregation appears to be controlled by longitudinal differences in stream environment that are both natural and human-caused. Habitat degradation, species selective fishing pressure, and migration barriers in downstream reaches, perhaps more than interaction between species, may have played the most significant role in creating this distribution (Peters 1990).

In general, fish sampling in the Blackfoot drainage in westslope cutthroat streams revealed very low densities of juvenile and adult fish. Of the 19 tributary streams sampled in 1989, only Beaver, Chamberlain and Poorman creeks carried densities of cutthroat trout ≥ 20 fish/100 ft. From 1990 to 1996, five additional streams were sampled that had a CPUE of ≥ 20 fish/100 ft (McCabe, Blanchard, Wasson, Yourname and Dick Creeks). Cutthroat trout are first observed in the Blackfoot River as 5 to 6 in. fish (age 2 to 3). These fish are suspected to be remnants of the fluvial life-history form.

Westslope cutthroat trout are dependant on quality tributary habitat for spawning, rearing and overwintering. Free access to large river systems is also necessary for the fluvial life-history form. Projects targeting these features have been completed on 21 streams with cutthroat trout. Improved fish passage and irrigation diversion structures have also benefitted cutthroat on 16 streams.

The migratory nature of westslope cutthroat trout in large river systems seems to provide some obvious competitive advantages and long-term viability in harsh environments like the Blackfoot River. However, less is known about specific aspects of the westslope's life history in the Blackfoot River than even bull trout. A wealth of scientific literature is available on westslope cutthroat trout, but most regards Idaho and northwest Montana populations. Virtually nothing is known about fluvial fish in the Clark Fork River basin upstream of the Flathead River. One of the primary impediments to acquiring knowledge has been the extremely low densities in the rivers of western Montana and the ineffectiveness of "traditional" tools in acquiring this knowledge (e.g. electrofishing, tagging and angler tag returns). Few fish were ever tagged, and a minuscule number of tag returns never provided definitive information. Failure to recognize the fluvial life-history form, and cutthroat trout in general for special consideration in fish management decisions further obscured our potential to learn about the needs of the fish.

However, special fishing regulations and native habitat restoration in the Blackfoot River drainage have resulted in significant increases in the numbers of large fluvial cutthroat. The increased populations now give biologists the opportunity to begin efforts to better understand the fish's life history and overall needs.

Restoration of the large fluvial westslope cutthroat trout in the Blackfoot River will initially require identification of critical habitats and basic information on movement patterns. Plans and funding to gather this information using radio telemetry began in 1997.

The changes to 1990 fishing regulations that prevent any harvest of westslope cutthroat drainage-wide, along with the restoration of degraded habitats, appears to have benefitted Blackfoot River cutthroat trout. Fine-tuning of restoration activities and goals is probably pre-mature at this time.

until further information has been collected on the fish's biology.

The Blackfoot River and its major tributaries have the potential for greatly enhanced populations of westslope cutthroat trout. Populations densities of westslope cutthroat trout have increased in the middle reaches of the Blackfoot River, as well as several tributaries. Population densities of westslope cutthroat trout ≥ 12 in. in the middle Blackfoot River have also increased from 1.0 fish/1000 ft in 1990 to 7.3 fish/1000 ft in 1996. Densities have fluctuated in the lower Blackfoot River; no recent trend is clear.

Life history

The Blackfoot River drainage contains resident and fluvial life-history forms of westslope cutthroat trout. Resident fish complete their entire life-cycle in first to third-order streams, attaining maximum sizes of approximately 4 to 12 in length. Fluvial westslope cutthroat trout rear in the lower sections of tributaries for one to three years before emigrating to the Blackfoot River during the late spring to early summer run-off. Little is known about the movement and habitat use of maturing fish in the Blackfoot River. Spawning fluvial fish migrate to tributaries during run-off. The timing of these migrations allows them to pass upstream of natural barriers, such as beaver dams and intermittent reaches of stream. After spawning these fish return to the Blackfoot River. They may grow > 20 in length. Currently less is known about fluvial westslope cutthroat spawning, rearing and migration than about bull trout.

Current Recovery Goals

No formal recovery plan has been drafted for westslope cutthroat in the Blackfoot River drainage. However, as with bull trout, significant activity has already occurred relative to recovery of westslope cutthroat trout. Current recovery goals for westslope cutthroat trout in the Blackfoot River drainage focus on re-establishing the fluvial life-history form by: 1) reducing or eliminating "controllable" sources of mortality (e.g., losses to irrigation ditches); 2) maintaining or enhancing existing spawning and rearing habitat; 3) restoring damaged habitats; and 4) re-establishing connection from the Blackfoot River to spawning tributaries.

RECOMMENDATIONS

1. Continue the current level of effort by the FWS Partners for Wildlife Program and FWP on the Blackfoot River Restoration Project. The Blackfoot River drainage is currently the site of one of the largest, and possibly one of the most successful, on-going ecosystem restoration efforts in the U.S. The approach we have used is unique in dealing with widespread ecosystem changes. The approach has been non-regulatory and relies heavily upon the abilities of private landowner and managers, and technical experts to communicate directly with each other. The continuation of this effort depends upon maintaining personnel with primary job responsibilities of contacting land owners and managers and providing funding incentives to incorporate necessary land management changes. This effort is considered educational at a very broad scale of land management and incorporates practices sensitive to both fish and wildlife. One wildlife specialist from the FWS and one fish specialist from FWP currently form the core of the restoration effort. Key support and additional valuable efforts should be provided through advisory staff of the Big Blackfoot Chapter of Trout Unlimited and the Blackfoot Challenge, as well as other agencies and organizations.
2. Write a bull trout restoration and management plan for the Blackfoot River basin over the 1997-98 period. All restoration goals need to identify the source of additional funding and personnel needs to accomplish the goal.
3. Continue long-term monitoring fish populations at Scotty Brown Bridge and

Johnsrud Sections of the Blackfoot River, Harry Morgan on the North Fork of the Blackfoot River, and in areas of tributary restoration efforts.

4. Continue monitoring stream water temperature in the Blackfoot River and tributary streams.
5. Continue monitoring efforts on all restoration projects and prepare comprehensive reports of progress every two years.
6. To help locate possible upwelling areas and potential bull trout spawning areas, Gold, Belmont, Lodgepole, Dunham, Arrastra, and Cottonwood Creeks need to be flown in the winter following extreme low temperature conditions.

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APPENDIX

Exhibit A: Catch per unit effort (CPUE) and size statistics for Blackfoot River tributaries, 1990 to 1996.

Exhibit B: Mark-recapture estimates in the Blackfoot River drainage, 1989 to 1996.

Exhibit C: Summary of two and three pass population estimates in the Blackfoot River drainage, 1990 to 1996.

Exhibit D: Table of restoration streams and activities.

Exhibit E: Table of restoration streams and cooperators.

Exhibit F: Rob Leary 2X electrophoresis letters-results.

Exhibit G: Water temperature monitoring station summaries for Blackfoot River and selected tributaries.

Exhibit H: Summary of stream discharge measurements in the Blackfoot River drainage, 1989 to 1996.

Exhibit I: Blackfoot River multi-spectral imagery specifications.

Exhibit J: Bull trout redd surveys in the Blackfoot River drainage, 1996.

Exhibit K: Blackfoot River whirling disease sample sites and results.

Exhibit L: Documented eastern brook trout fish plants in the Blackfoot River drainage from microfiche records.

Exhibit A. Catch per unit effort (CPUE) and size statistics for Blackfoot River tributaries, 1990 to 1996

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number	Number Captured	YOY Captured	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
						1st Pass	1st Pass	1st Pass	(in)	(in)		
Arrastra Creek	0.7	14N, 10W, 29B	26-Aug-96	440	CT*	20	12	9	2.9-8.5	3.9	2.7	2.0
					EB	36	13	1	3.7-6.8	3.9	3.0	0.2
					LL	87	43	39	2.0-6.7	2.8	9.8	8.9
					MWF	18	12	12	2.9-3.5	3.2	2.7	2.7
	2.4	14N, 10W, 17D	28-Aug-96	200	CT	12	9	2	1.7-10.9	7.1	4.5	1.0
					DV	1	1	0	3.5	3.5	0.5	0.0
					EB	57	34	31	1.4-9.7	3.9	17.0	15.5
Basin Creek	9.2	15N, 10W, 24C	28-Aug-96	300	CT	17	17	0	6.1-9.4	7.5	5.7	0.0
					DV	1	1	0	7.8	7.8	0.3	0.0
	0.7	15N, 13W, 33B	05-Sep-91	270	EB	55	45	34	2.2-7.5	3.8	16.7	12.6
					LNS	36	23	0	4.0-7.1	5.2	8.5	0.0
					RB	1	1	0	5.2	5.2	0.4	0.0
			24-Jul-95	360	CT	2	2	0	6.3-7.5	7.0	0.6	0.0
					EB	15	15	13	1.5-6.7	3.0	4.2	3.6
Bear Creek	1.1	13N, 16W, 18B; 13N, 16W, 7C	20-Jun-94	345	EB	6	5	0	4.2-5.6	5.0	1.4	0.0
					LL	7	5	0	3.7-8.4	5.3	1.4	0.0
					RB	12	8	8	2.4-3.9	3.2	2.3	2.3
	1.5	13N, 16W, 13B	25-Jul-95	300	CT	2	2	0	4.5-4.9	4.8	0.7	0.0
					EB	26	18	9	1.9-7.3	3.5	6.0	3.0
					LL	1	0	1	5.5	5.5	0.0	0.3
					RB	18	14	3	3.5-6.5	4.4	4.7	1.0
Belmont Creek	1.8	13N, 17W, 13D	20-Jun-94	210	SCUL	Present						
					EB	13	11	3	3.5-6.8	4.6	5.2	1.4
					RB	14	9	3	2.9-5.3	4.0	4.3	1.4
	2.9	13N, 17W, 24C	20-Jun-94	75	EB	4	4	0	4.4-5.7	5.1	5.3	0.0
					LL	1	1	0	4.7	4.7	1.3	0.0
					RB	8	8	5	2.4-6.1	4.0	10.7	6.7
	0.6	14N, 16W, 24B	15-Sep-94	360	DV	4	3	0	6.7-8.8	7.4	0.8	0.0
Blackfoot River, H2-0 ditch					EB	1	1	0	8.3	8.3	0.3	0.0
					LL	40	33	13	2.7-10.7	6.2	9.2	3.6
					RB	413	278	214	1.4-9.4	2.8	77.2	59.4
	83.7	14N, 11W, 26B	24-Jul-95	525	CT	2	2	0	4.3-4.5	4.5	0.4	0.0
					LL	26	26	21	2.2-10.3	3.7	5.0	4.0
					LNS	1	-	-	3.7	3.7	0.0	0.0
					MWF	7	7	-	2.7-3.2	2.9	1.3	0.0
Blanchard Creek	0.1	14N, 14W, 5A	22-Aug-90	310	EB	1	0	0	6.7	6.7	0.0	0.0
					LL	2	2	2	3.2-3.7	3.5	0.6	0.6
					RB	70	50	39	2.2-7.6	3.1	16.1	12.6
			14-Sep-95	420	CT	2	2	0	5.5-6.5	6.1	0.5	0.0
					LL	16	11	6	2.9-6.9	4.3	2.6	1.4
					RB	197	147	107	2.2-9.4	3.4	35.0	25.5
					LND	9	6	0	1.3-3.0	1.7	1.4	0.0
Chamberlin Creek					LSS	3	3	0	1.2-1.8	1.7	0.7	0.0
					MWF	7	7	6	3.3-4.3	3.8	1.7	1.4
					NSF	11	11	0	2.4-2.7	2.8	2.6	0.0
					SCUL	Common						
	1.1	14N, 14N, 5B	22-Aug-90	126	CT	1	1	0	9.0	9.0	0.8	0.0
					LL	1	0	0	3.8	3.8	0.0	0.0
					RB	156	107	45	1.7-7.9	4.1	84.9	35.7
Cottonwood Creek	3.3	15N, 15W, 36AB	22-Aug-90	230	CT	63	63	43	1.8-8.0	3.4	27.4	18.7
	0.1	15N, 13W, 32	12-Sep-95	282	CT*	82	69	40	1.6-7.3	3.4	24.5	14.2
	0.1	15N, 13W, 32	12-Sep-95	282	LL	45	32	25	2.3-7.9	3.8	11.3	8.9
					RB	1	1	0	4.5	4.5	0.4	0.0
					LNS	1	0	0	4.1	4.1	0.0	0.0
					RSS	Present						
					SCUL	Common						
Cottonwood Creek	0.5	15N, 13W, 3D	12-Sep-95	336	CT*	81	61	33	2.5-8.5	3.8	18.2	9.8
					LL	6	4	3	3.4-9.7	3.4	1.2	0.9
					RB	6	5	0	4.0-5.0	4.6	1.5	0.0
					LNS	Common						
					RSS	Present						
					SCUL	Common						
	4.4	15N, 13W, 17A	23-Jun-92	150	LL	11	11	0	4.3-11.6	6.7	7.3	0.0
Cottonwood Creek	4.7	15N, 13W, 8D	28-Jul-92	240	DV	1	0	0	12.7	12.9	0.0	0.0
					EB	6	2	0	6.1-9.1	7.2	0.8	0.0
					LL	86	69	14	2.5-21.3	6.7	28.8	5.8
					MWF	1	1	0	2.7	2.7	0.4	0.0
	5.0	15N, 13W, 8D	07-Jul-92	225	EB	1	1	0	6.2	6.2	0.4	0.0
					LL	18	14	2	2.0-14.3	7.9	6.2	0.9
					MWF	3	3	0	15.2-15.6	15.5	1.3	0.0
Cottonwood Creek	5.5	15N, 13W, 8D	28-Jul-92	300	CT	1	0	0	9.6	9.6	0.0	0.0
					EB	1	1	0	7	7.0	0.3	0.0

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number	Number Captured	YOY Captured	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
						Captured	1st Pass	1st Pass	(in)	(in)		
Cottonwood Creek (cont)	5.5	15N, 13W, 8D	28-Jul-92	300	LL	70	45	0	2.2-18.0	8.4	15.0	0.0
	7.0	15N, 13W, 5D	07-Nov-91	180	CT	2	0	0	1.8-5.3	3.6	0.0	0.0
					EB	9	4	1	3.3-7.9	5.6	2.2	0.6
					LL	10	7	2	2.4-15.2	6.3	3.9	1.1
	7.5	15N, 13W, 5C	01-May-91	690	CT	2	2	1	2.2-12.4	7.4	0.3	0.1
					EB	29	29	8	1.3-7.9	4.9	4.2	1.2
					LL	17	17	6	2.6-14.3	7.2	2.5	0.9
	7.5	15N, 13W, 5	23-Jul-91	285	CT	6	3	1	3.5-11.8	5.5	1.1	0.4
					EB	117	79	57	1.2-8.1	4.0	27.7	20.0
					LL	72	35	27	1.2-13.5	2.8	12.3	9.5
Boyd Ditch spring creek @ mi 6.3					SCUL	Common						
	4.9	15N, 13W, 17A	28-Jul-92	150	LL	10	10	0	4.3-9.6	7.2	6.7	0.0
	0.1	15N, 13W, 5D	07-Nov-91	231	EB	19	11	4	3.2-8.7	4.7	4.8	1.7
					LL	38	29	6	2.8-16.4	7.4	12.6	2.6
	0.1	15N, 13W, 5D	07-Nov-91	186	CT	1	1	1	3.7	3.7	0.5	0.5
					EB	45	27	10	2.5-8.2	4.6	14.5	5.4
					LL	9	7	3	2.0-4.8	3.9	3.8	1.6
	0.1	15N, 13W, 5C	01-May-91	230	CT	1	1	1	2.3	2.3	0.4	0.4
					EB	38	38	13	2.4-10.0	4.5	16.5	5.7
					LL	7	7	7	2.7-3.3	3.2	3.0	3.0
spring creek @ mi 7.5					SCUL	Present						
	0.1	15N, 13W, 5C	23-Jul-91	130	CT	1	1	1	3.8	3.8	0.8	0.8
					EB	46	46	5	2.3-7.2	5.0	35.4	3.8
					LL	3	3	1	3.8-4.4	4.2	2.3	0.8
	0.1	15N, 13W, 13D	06-May-92	420	CT	1	1	0	4.4	4.4	0.2	0.0
					LL	7	7	0	4.0-17.6	7.2	1.7	0.0
					RB	8	8	5	2.3-7.1	4.2	1.9	1.2
					LND	3	0	0	2.3-3.5	3.0	0.0	0.0
					MWF	4	4	0	7.9-11.0	9.4	1.0	0.0
					SCUL	Present						
Dick Creek	0.8	15N, 13W, 13D	06-May-92	243	EB	3	3	0	4.0-9.0	6.8	1.2	0.0
					LL	3	3	0	4.4-7.9	5.8	1.2	0.0
					RB	5	5	3	2.5-7.9	4.6	2.1	1.2
					LND	2	0	0	1.6-1.8	1.7	0.0	0.0
					LNS	1	0	0	14.8	14.8	0.0	0.0
					MWF	2	2	0	7.5-7.9	7.8	0.8	0.0
	8.8	15N, 12W, 3A	27-Jun-92	100	CT	20	20	5	3.2-7.0	4.4	20.0	5.0
					EB	9	9	5	2.9-7.5	4.6	9.0	5.0
Douglas Creek	0.2	13N, 11W, 9C	05-Aug-94	285	No fish observed							
	8.0	12N, 11W, 6AC	05-Aug-94	100	LND	Present						
					LSS	Present						
					RSS	Present						
Dry Creek	15.3	12N, 12W, 19B	05-Aug-94	126	CT	13	13	5	2.8-5.4	4.1	10.3	4.0
	0.2	15N, 10W, 17C	30-Jun-94	330	CT	9	9	2	2.4-5.5	4.4	2.7	0.6
					EB	1	1	0	5.6	5.6	0.3	0.0
Dunham Creek	2.3	16N, 12W, 19B	07-Aug-96	400	CT	18	13	6	2.9-16.3	5.4	3.3	1.5
					DV	11	7	0	4.4-10.1	6.4	1.8	0.0
					EB	2	2	0	6.3, 6.7	6.6	0.5	0.0
	4.2	16N, 13W, 12D	07-Aug-96	655	CT	3	2	2	3.3-6.9	4.7	0.3	0.3
	5.5	16N, 13W, 2D	07-Aug-96	600	CT	2	2	0	4.0, 8.8	6.4	0.3	0.0
canal @ mi 2.1					DV	2	2	2	1.9, 2.0	2.0	0.3	0.3
	0.1	16N, 13W, 19B	29-Jun-95	350	DV	2	2	0	3.6, 3.6	3.6	0.2	0.0
	2.3	16N, 13W, 19D	15-Jul-96	1000	CT	5	5	4	2.7-5.5	3.5	0.5	0.4
East Twin Creek	0.1	13N, 17W, 2D	16-Aug-96	60	CT	1	1	0	8.1	8.1	1.7	0.0
					LL	2	2	2	2.1-2.5	2.4	3.3	3.3
					RB	1	1	1	1.1	1.1	1.7	1.7
	0.2	13N, 17W, 2C	16-Aug-96	460	CT*	9	9	6	3.1-5.1	3.7	2.0	1.3
					EB	15	15	5	2.2-7.5	4.8	3.3	1.1
					LL	11	11	10	1.6-5.1	2.2	2.4	2.2
					RB	3	3	3	3.2-3.3	3.2	0.7	0.7
	0.7	14N, 17W, 35C	16-Aug-96	300	EB	27	27	8	2.1-6.2	3.7	9.0	2.7
					RB	20	20	20	2.4-5.9	3.3	6.7	6.7
	1.9	14N, 17W, 26C	16-Aug-96	185	CT*	4	4	2	2.6-4.8	3.9	2.2	1.1
Elk Creek					EB	12	12	1	2.1-6.8	4.5	6.5	0.5
					RB	2	2	1	3.1-4.7	4.0	1.1	0.5
	0.1	14N, 15W, 26D	03-Oct-91	198	EB	1	1	1	3.4	3.4	0.5	0.5
					RB	8	6	5	2.0-4.5	2.6	3.0	2.5
					MWF	1	1	0	3.7	3.7	0.5	0.0
					SCUL	Present						
					LL	1	1	0	4.0	4.0	0.3	0.0
				25-Sep-96	355	RB	16	11	2	2.5-8.5	5.4	3.1

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number	Number Captured	YOY	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
						Captured	1st Pass	1st Pass	(in)	(in)		
Elk Creek (cont'd)	0.1	14N, 15W, 26D	25-Sep-96	355	LND	Present						
	1.1	14N, 15W, 36A	03-Oct-91	186	SCUL	Common						
					CT	1	1	0	5.8	5.8	0.5	0.0
					EB	3	3	0	4.5-7.7	7.0	1.6	0.0
					LL	1	1	0	4.2	4.2	0.5	0.0
					RB	22	15	8	2.2-9.6	4.0	8.1	4.3
			25-Sep-96	350	SCUL	Abundant						
	2.3	14N, 14W, 31B	14-Sep-95	375	RB	10	10	2	2.5-11.0	6.2	2.9	0.6
					LNS	Present						
					LSS	Present						
					SCUL	Common						
			25-Sep-96	380	EB	3	2	0	6.6-8.0	7.5	0.5	0.0
					RB	11	5	3	2.2-6.6	3.5	1.3	0.8
					LNS	Present						
					SCUL	Abundant						
	3.0	14N, 14W, 32C	03-Oct-91	108	CT*	2	2	0	8.5-9.5	9.1	0.5	0.0
					LL	4	4	4	1.7-2.7	2.0	1.1	1.1
					RB	31	22	17	2.0-10.5	3.5	5.8	4.5
			25-Sep-96	385	LNS	Present						
					SCUL	Abundant						
					EB	7	6	4	3.5-8.0	4.3	1.6	1.0
					RB	65	40	35	1.0-6.2	3.0	10.4	9.1
	4.6	13N, 14W, 5D	03-Oct-91	105	CT	11	11	7	1.6-6.0	3.3	10.5	6.7
					EB	53	46	29	2.4-9.0	4.1	43.8	27.6
					RB	6	6	3	2.3-5.5	3.8	5.7	2.9
					SCUL	Present						
	12.2	12N, 14W, 1B	01-Nov-96	235	EB	18	12	7	3.5-10.8	5.4	5.1	3.0
Finley Creek	1.9	16N, 16W, 23B	19-Jul-95	275	CT	10	10	4	3.0-6.2	4.6	3.6	1.5
					EB	6	6	0	5.3-8.4	6.2	2.2	0.0
Frazier Reservoir	2	14N, 12W, 32A	11-Aug-94	3 hours	SCUL	Common						
Gold Creek	0.2	14N, 16W, 31B	05-Aug-96	592	CT	129	129	1	3.8-13.2	9.0	-	-
					CT*	3	1	0	4.4-8.4	6.4	0.2	0.0
					DV	2	1	0	12.6, 12.8	12.9	0.2	0.0
					LL	34	14	5	2.2-10.7	4.2	2.4	0.8
					RB	41	17	8	2.2-7.9	4.4	2.9	1.4
					LND	Present						
	1.9	14N, 16W, 30D	06-Aug-96	400	CT*	3	1	0	4.3-4.9	4.7	0.3	0.0
					LL	18	14	0	76-345	6.1	3.5	0.0
					RB	16	7	3	82-225	4.8	1.8	0.8
	2.5, 2.7	14N, 16W, 30B	06-Aug-96	569	CT*	5	5	2	70-235	6.0	0.9	0.4
					DV	3	3	0	175-221	8.0	0.5	0.0
					LL	41	33	1	2.0-17.1	7.7	5.8	0.2
					RB	34	20	11	2.6-13.8	5.2	3.5	1.9
					MWF	Present						
Grantier Spring Creek	1.0	14N, 9W, 25A	02-Jul-91	700	EB	169	129	89	1.0-11.0	4.4	18.4	12.7
					LL	108	80	27	1.9-12.8	5.3	11.4	3.9
			25-Jul-94	258	EB	129	76	67	2.0-15.8	3.4	29.5	26.0
					LL	134	67	54	1.7-7.3	3.0	26.0	20.9
Hogum Creek	0.1	14N, 7W, 8B	10-Aug-95	108	CT	8	8	0	5.3-8.1	6.6	7.4	0.0
					EB	6	6	2	2.1-8.3	5.5	5.6	1.9
					MWF	1	1	-	2.6	2.6	0.9	0.0
Hoyt Creek	0.2	15N, 12W, 19B	08-Sep-92	200	CT	1	1	0	4.9	4.9	0.5	0.0
					EB	33	22	6	2.8-9.6	4.5	11.0	3.0
					LL	3	2	2	3.0-4.1	3.7	1.0	1.0
					RB	20	12	10	2.0-6.5	3.0	6.0	5.0
					LNS	1	1	0	6.4	6.4	0.5	0.0
					MWF	28	10	7	3.1-5.0	3.6	5.0	3.5
	1.1	15N, 12W, 19C	27-Jul-92	165	No fish observed							
Humbug Creek	3.9	15N, 12W, 28D	27-Jul-92	200	EB	29	29	12	2.4-8.2	5.2	14.5	6.0
	1.7	14N, 8W, 31B	26-Jul-95	500	CT	69	69	29	1.5-6.8	3.9	13.8	5.8
Kleinschmidt Creek	0.1	14N, 11W, 6A	24-Jul-89	490	EB	3	3	2	2.9-6.8	4.6	0.6	0.4
					CT	1	1	0	5.1	5.1	0.2	0.0
					LL	49	49	39	2.1-19.5	4.1	10.0	8.0
			26-Jul-94	100	RB	18	12	12	1.1-2.4	1.5	12.0	12.0
					LL	163	73	72	2.0-6.0	3.0	73.0	72.0
Lincoln Spring Creek	1.4	14N, 9W, 23B	20-Jul-95	360	LL	21	15	4	1.8-16.3	6.6	4.2	1.1
	2.1	14N, 9W, 23A	20-Jul-95	325	EB	2	2	0	6.7-7.7	7.3	0.6	0.0
					LL	55	39	12	1.7-16.2	4.8	12.0	3.7
	2.4	14N, 9W, 24B	20-Jul-95	282	EB	10	8	1	1.8-6.7	4.8	2.8	0.4
					LL	30	23	6	1.9-19.5	7.0	8.2	2.1
					SCUL	Present						

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number	Number Captured	YOY Captured	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
						Captured 1st Pass	Present	1st Pass	(in)	(in)	in 1st Pass	YOY CPUE (#/100' in 1st Pass)
Lodgepole Creek	0.4	17N, 13W, 36B	07-Aug-96	540	CT	22	22	1	3.5-11.4	7.1	4.1	0.2
					DV	5	5	0	5.6-19.8	9.5	0.9	0.0
					SCUL							
McCabe Creek	2.2	15N, 12W, 5C	08-Sep-95	504	CT	72	72	27	3.1-9.6	4.7	14.3	5.4
					EB	11	11	1	2.4-7.1	5.6	2.2	0.2
below culvert	2.5	15N, 12W, 5C	10-Sep-92	150	CT	61	49	25	1.6-11.7	5.0	32.7	16.7
			08-Sep-95	100	CT	15	15	3	1.2-7.1	4.9	15.0	3.0
above culvert	2.5	15N, 12W, 5DC	10-Sep-92	135	CT	31	28	7	1.6-6.2	4.4	20.7	5.2
	3.2	15N, 12W, 4C	16-Sep-92	150	CT	31	25	5	1.1-8.0	5.0	16.7	3.3
ditch @ mi 2.2	0.1	15N, 12W, 5C	08-Sep-95	300	CT	12	12	-	-	-	4.0	0.0
Monture Creek	0.4	15N, 13W, 27C	03-Aug-94	189	CT*	2	2	0	4.3	4.4	1.1	0.0
					LL	12	12	12	2.0-2.8	2.4	6.3	6.3
					RB	82	82	81	1.1-4.8	1.8	43.4	42.9
					LND							
	2.2	15N, 13W, 22D	03-Aug-94	321	CT	1	1	0	9.0	9.0	0.3	0.0
					DV	1	1	0	15.8	15.8	0.3	0.0
					LL	5	5	3	2.2-10.2	5.4	1.6	0.9
					RB	66	66	58	1.1-11.6	2.2	20.6	18.1
	5.4	15N, 13W, 13A	04-Aug-94	545	CT	9	9	2	3.7-16.3	7.3	1.7	0.4
					EB	4	4	2	2.5-5.7	4.3	0.7	0.4
					LL	10	10	10	2.0-2.7	2.3	1.8	1.8
					RB	21	21	14	1.3-5.7	2.6	3.9	2.6
	8.6	15N, 12W, 6C	04-Aug-94	689	CT	15	15	13	1.4-14.0	3.0	2.2	1.9
					DV	4	4	2	2.4-3.5	2.8	0.6	0.3
					EB	19	19	16	2.0-5.4	3.1	2.8	2.3
					LL	7	7	6	2.4-5.5	3.0	1.0	0.9
	12.9	16N, 12W, 29B	03-Aug-94	450	CT	9	9	8	2.4-5.7	3.4	2.0	1.8
					DV	30	30	28	2.0-5.1	2.7	6.7	6.2
					EB	14	14	4	2.4-7.1	4.4	3.1	0.9
Morrell Creek	0.1	16N, 15W, 14BA	05-Sep-90	346	DV	1	1	0	9.3	9.3	0.3	0.0
					EB	35	26	17	1.7-6.0	3.2	7.5	4.9
					LL	38	24	21	1.7-8.1	2.7	6.9	6.1
					SCUL							
	4.3	17N, 15W, 25CD	05-Sep-90	300	CT	19	19	11	2.8-6.6	4.0	6.3	3.7
					DV	18	18	7	2.6-11.0	4.5	6.0	2.3
					EB	5	5	0	4.8-10.3	7.5	1.7	0.0
Murray Creek	3.0	12N, 12W, 8	05-Aug-94	150	CT	14	14	7	2.7-5.6	4.7	9.3	4.7
					SCUL							
Nevada Creek	0.0-3.8	13N, 11W, 8D; 13N, 11W, 7D	12-Apr-90	20064	LL	1	1	0	11.5	11.5	0.0	0.0
					LNS							
					LSS							
					NSF							
					RSS							
	0.7	13N, 11W, 7D	09-Sep-94	500	LL	1	1	0	7.3	7.3	0.2	0.0
					LND	2	2	-	2.0-3.1	2.6	0.4	0.0
					LSS	21	14	-	2.8-6.8	4.6	2.8	0.0
					NSF	23	16	-	2.9-8.7	5.2	3.2	0.0
					RSS	2	1	-	4.0-4.1	4.1	0.2	0.0
					SCUL	4	2	-	2.4-4.0	3.0	0.4	0.0
	12.5	13N, 11W, 23A	09-Sep-94	500	LND	1	1	-	2.0	2.0	0.2	0.0
					LNS	7	5	-	5.3-7.3	6.3	1.0	0.0
					LSS	63	48	-	2.0-16.3	6.8	9.6	0.0
					RSS	24	16	-	2.3-4.3	3.4	3.2	0.0
	25.7	12N, 10W, 5A	09-Aug-94	420	LND	1	1	-	2.3	2.3	0.2	0.0
					LNS	24	22	-	1.5-6.5	3.4	5.2	0.0
					NSF	1	1	-	2.4	2.4	0.2	0.0
					RSS	18	11	-	0.9-3.4	2.3	2.6	0.0
					SCUL							
	29.0	12N, 10W, 11D	12-Apr-90	400	RB	3	3	1	3.6-5.5	4.5	0.8	0.3
					LNS	1	1	-	6.6	6.6	0.3	0.0
					LSS	7	7	-	5.5-18.7	13.5	1.8	0.0
					MWF	2	2	-	11.6-15.8	13.8	0.5	0.0
	29.0	12N, 10W, 11C	09-Aug-94	430	RB	3	1	-	4.8-6.4	5.6	0.2	0.0
					LSS	5	4	-	2.6-18.8	10.2	0.9	0.0
					MWF	1	0	-	8.6	8.6	0.0	0.0
					RSS							
					SCUL							
	31.0	12N, 9W, 19A	23-Jul-96	400	RB*	3	2	0	2.9-11.0	9.0	0.5	0.0
					LND	11	6	0	2.5-4.1	3.0	1.5	0.0
					LNS	2	1	0	12.4, 15.8	14.2	0.3	0.0
					LSS	51	36	9	2.0-20.0	12.3	9.0	2.3
					RSS	4	2	0	1.6-2.4	2.0	0.5	0.0
					SCUL	71	59	0	2.4-4.7	3.2	14.8	0.0
	33.0	12N, 9W, 35B	24-Jul-96	350	EB	35	28	0	5.1-10.0	7.0	8.0	0.0

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number 1st Pass	YOY 1st Pass	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
Nevada Creek (cont'd)	33.0	12N, 9W, 35B	24-Jul-96	350	LNS	1	1	0	4.0	4.0	0.3	0.0
					SCUL	13	13	0	2.7-4.3	3.5	3.7	0.0
	33.8	12N, 9W, 25	23-Jul-96	300	EB	48	34	11	2.0-11.4	4.8	11.3	3.7
					RB*	10	2	1	3.5-5.5	4.6	0.7	0.3
					SCUL	131	69	0	1.5-4.6	2.6	23.0	0.0
	40.8	12N, 8W, 30	24-Jul-96	510	CT*	5	5	5	2.9-3.3	3.2	1.0	1.0
					EB	10	10	8	1.8-5.7	2.7	2.0	1.6
					SCUL	54	54	0	1.6-4.2	2.8	10.6	0.0
	42.1	12N, 8W, 15A	23-Jul-96	405	CT	18	18	6	2.2-5.8	4.2	4.4	1.5
					SCUL	34	34	0	1.4-4.3	3.1	8.4	0.0
Nevada Spring Creek	3.0	13N, 11W, 11D	26-Jul-90	2000	LL	33	26	14	2.3-24.4	7.3	1.3	0.7
					LSS	2	2	0	16.0-16.7	16.4	0.1	0.0
			15-Aug-91	795	CT	1	1	0	10.4	10.4	0.1	0.0
					LL	36	29	12	2.6-16.6	6.2	3.6	1.5
			17-Aug-92	795	LL	158	103	69	2.8-23.4	4.4	13.0	8.7
			14-Jul-94	795	LL	139	79	43	2.0-17.6	4.5	9.9	5.4
North Fork Blackfoot River	2.6	14N, 12W, 11C	09-Sep-94	336	DV	2	2	0	5.3-6.1	5.8	0.6	0.0
					EB	1	1	0	4.8	4.8	0.3	0.0
					LL	20	20	12	2.2-9.0	4.2	6.0	3.6
					RB	8	8	5	1.5-4.8	3.8	2.4	1.5
					LND	Present						
	7.9	14N, 12W, 10D, 11D	09-Sep-94	405	CT	1	1	0	5.0	5.0	0.2	0.0
					DV	10	10	4	2.5-7.3	4.4	2.5	1.0
					LL	2	2	1	2.7-8.2	5.6	0.5	0.2
					RB	3	3	0	4.1-4.5	4.4	0.7	0.0
	11.5	15N, 11W, 15C	02-Aug-94	300	DV	2	2	1	2.0-4.8	3.7	0.7	0.3
	17.2	16N, 11W, 35B	02-Aug-94	162	CT	1	1	0	6.4	6.4	0.6	0.0
					DV	21	21	17	1.8-7.3	3.1	13.0	10.5
					RB	3	3	0	2.9-3.4	3.2	1.9	0.0
ditch @ mi 8.8	0.2	15N, 11W, 29B	07-Jul-95	1140	CT	2	2	0	14.8-16.4	15.6	0.2	0.0
					DV	3	3	0	7.3-8.3	8.1	0.3	0.0
					EB	1	1	0	8.4	8.4	0.1	0.0
					LL	2	2	0	5.0-5.1	5.2	0.2	0.0
					RB	2	2	0	6.5-10.2	8.5	0.2	0.0
ditch @ mi 10.0	0.1	15N, 11W, 21C	23-Sep-94	300	RB	1	1	0	7.6	7.6	0.3	0.0
					LL	2	2	0	9.0-11.8	10.6	0.7	0.0
			28-Aug-96	375	MWF	2	2	0	3.1-4.0	3.6	0.7	0.0
					DV	20	20	18	2.0-18.0	3.0	5.3	4.8
					EB	1	1	0	8.0	8.0	0.3	0.0
					WF	4	4	0	-	-	1.1	0.0
					SCUL	Abundant			-	-	0.0	0.0
ditch @ mi 10.7	0.2	15N, 11W, 28C, 15N, 11W, 29D	22-Sep-94	210	DV	1	1	0	20.8	20.8	0.5	0.0
					MWF	38	38	0	3.1-4.5	4.1	18.1	0.0
					RSS	1	1	0	2.8	2.8	0.5	0.0
			05-Sep-96	800	CT*	1	1	1	8.0	8.0	0.1	0.1
					DV	14	14	12	-	-	1.8	1.5
					LL	2	2	0	-	-	0.3	0.0
ditch @ mi 12.3	0.1	15N, 11W, 15D	08-Jul-94	380	CT	1	1	0	10.4	10.4	0.3	0.0
					DV	3	3	1	2.0-14.6	7.6	0.8	0.3
					LL	2	2	0	5.1-9.2	7.3	0.5	0.0
					SCUL	Present						
	0.2	15N, 11W, 14A	27-Aug-96	760	CT	1	1	0	7.0	7.0	0.1	0.0
					DV	122	122	104	2.1-6.6	5.5	16.1	13.7
					SCUL	Present						
	0.2	15N, 11W, 14A	27-Aug-96	760	CT	1	1	0	7.0	7.0	0.1	0.0
					DV	122	122	104	2.1-6.6	5.5	16.1	13.7
ditch @ mi 15.3	0.4	15N, 11W, 14A	12-Sep-96	1000	DV	34	34	29	2.1-7.8	3.0	3.4	2.9
	0.1	15N, 11W, 2C	01-Jul-94	396	CT	1	1	0	17.8	17.8	0.3	0.0
					DV	20	20	13	1.5-7.2	3.0	5.1	3.3
			02-Aug-94	180	DV	47	47	47	1.8-2.7	2.3	26.1	26.1
			22-Sep-94	380	DV	22	20	20	2.2-6.9	3.1	5.3	5.3
	1.4	15N, 11W, 14A	11-Jul-94	480	DV	1	1	0	5.3	5.3	0.2	0.0
					CT	1	1	0	7.8	7.8	0.2	0.0
			22-Sep-94	720	CT	1	1	0	7.4	7.4	0.1	0.0
Owl Creek	1.2	16N, 15W, 26AC	23-Aug-90	500	LL	6	6	2	2.7-14.5	8.6	1.2	0.4
					RB	4	4	1	1.9-7.5	5.9	0.8	0.2
					LND	Present						
					LSS	Common						
					MWF	1	1	1	3.2	3.2	0.2	0.2
					NSF	Common						
					RSS	Abundant						
	2.4	15N, 16W, 27B	23-Aug-90	275	LL	18	18	13	2.7-14.1	5.3	6.5	4.7
					RB	4	4	4	2.3-3.3	2.7	1.5	1.5
					LND	5	5	-	3.3-4.8	3.8	1.8	0.0
					LSS	3	3	-	1.5-3.9	2.5	1.1	0.0
					NSF	1	1	-	1.5	1.5	0.4	0.0
	4.2	16N, 15W, 28D	19-Jul-95	50	LL	2	2	0	6.1-15.8	11.0	4.0	0.0
					RB	2	2	0	5.5-6.1	5.9	4.0	0.0

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass	YOY CPUE (#/100' in 1st Pass
						Captured	1st Pass	1st Pass	(in)	(in)	in 1st Pass	in 1st Pass
Owl Creek (cont'd)					LNS	1	1	0	15.2	15.2	2.0	0.0
					MWF	7	7	0	10.4-12.2	11.7	14.0	0.0
Pearson Creek	0.2	15N, 13W, 33B	24-Jul-95	600	CT	1	1	0	6.0	6.0	0.2	0.0
					EB	2	2	2	2.7-2.9	2.9	0.3	0.3
					LNS	2	2	-	5.9-6.7	6.4	0.3	0.0
	0.8	15N, 13W, 33A	19-Apr-94	250	CT	1	1	0	195	195.0	0.4	0.0
	1.5	14N, 13W, 3C	11-Apr-94	400	CT	54	54	7	2.0-9.8	5.2	13.5	1.8
Placid Creek	3.2	17N, 15W, 25C,I	23-Aug-90	400	CT	2	2	1	3.7-8.4	6.1	0.5	0.3
					EB	28	28	2	2.2-10.7	6.4	7.0	0.5
					RB	31	31	24	2.3-7.2	3.6	7.8	6.0
	3.2	16N, 16W, 13C	19-Jul-95	492	CT*	3	3	2	2.9-6.1	4.3	0.6	0.4
					EB	47	47	10	1.8-8.7	5.2	9.6	2.0
					SCUL	Present						
	4.6	16N, 16W, 14B	19-Jul-95	330	CT	4	4	3	2.6-5.6	3.9	1.2	0.9
					EB	46	46	13	2.0-11.2	5.3	13.9	3.9
Nick's Spring Creek	0.2	16N, 16N, 23A	19-Jul-95	235	CT	5	5	1	3.6-5.5	4.7	2.1	0.4
					SCUL	Present						
Poorman Creek	4.4	13N, 8W, 8CB	08-Nov-91	255	CT	158	109	10	1.8-10.8	8.2	42.7	3.9
					DV	2	1	0	8.7-9.8	9.4	0.4	0.0
					EB	7	3	1	3.6-9.4	7.1	1.2	0.4
					LL	1	1	0	14.6	14.6	0.4	0.0
Rock Creek	0.0	14N, 11W, 6A	20-Jul-89	385	CT	2	2	1	3.7-4.2	4.0	0.5	0.3
					EB	3	3	1	2.3-5.8	4.2	0.8	0.3
					LL	10	10	7	2.5-5.8	3.6	2.6	1.8
					RB	5	5	2	1.3-5.0	3.4	1.3	0.5
					LND	Common						
					SCUL	Common						
	0.2-Aug-94			385	CT	1	1	0	4.3	4.3	0.3	0.0
					EB	1	1	1	1.8	1.8	0.3	0.3
					LL	80	80	67	1.8-9.4	3.4	20.8	17.4
					RB	49	49	43	1.0-8.5	2.0	12.7	11.2
					MWF	3	3	3	2.0-3.5	2.6	0.8	0.8
					SCUL	Common						
	0.1	14N, 11W, 6A	20-Jul-89	346	EB	10	10	3	2.6-6.7	5.4	2.9	0.9
					LL	36	36	31	2.1-6.8	3.1	10.4	9.0
					RB	31	31	17	1.2-8.8	3.7	9.0	4.9
	28-Jul-94			352	CT	1	1	0	4.4	4.4	0.3	0.0
					EB	6	5	3	2.6-12.2	5.3	1.4	0.9
					LL	228	152	126	1.6-18.5	3.4	43.2	35.8
					RB	155	118	107	1.1-7.5	2.2	33.5	30.4
					SCUL	Common						
	0.7	14N, 11W, 5B	21-Jul-89	205	EB	19	19	19	2.2-3.1	2.6	9.3	9.3
					LL	3	3	3	2.5-2.8	2.7	1.5	1.5
					RB	14	14	14	1.2-1.6	1.3	6.8	6.8
	03-Aug-90			496	CT	6	4	1	3.8-4.4	4.1	0.8	0.2
					DV	1	1	0	16.2	16.2	0.2	0.0
					EB	104	75	70	2.0-8.7	2.9	15.1	14.1
					LL	30	19	19	2.1-7.2	3.0	3.8	3.8
					RB	5	4	1	3.0-8.1	6.1	0.8	0.2
	29-Jul-94			469	CT	1	1	0	6.4	6.4	0.2	0.0
					EB	37	28	20	2.1-10.7	3.7	6.0	4.3
					LL	186	141	133	1.4-13.2	3.0	30.1	28.4
					RB*	140	138	132	1.0-7.4	1.7	29.4	28.1
					SCUL	Common						
	1.2	14N, 11W, 5A	21-Jul-89	411	EB	34	34	27	2.1-7.8	3.7	8.3	6.6
					LL	6	6	2	2.6-12.0	6.7	1.5	0.5
					SCUL	Present						
	29-Jul-94			411	CT	3	3	0	4.3-6.0	5.1	0.7	0.0
					DV	1	1	0	7.8	7.8	0.2	0.0
					EB	40	38	38	2.4-6.7	3.1	9.7	9.2
					LL	20	17	17	2.5-5.8	3.6	4.9	4.1
					RB	3	3	1	2.5-5.2	4.2	0.7	0.2
	1.4	14N, 11W, 5A	24-Jul-89	302	EB	24	24	17	2.7-6.4	4.3	7.9	5.6
					LL	1	1	1	3.0	3.0	0.3	0.3
					LND	Present						
					SCUL	Present						
	29-Jul-94			246	EB	35	35	34	2.0-4.1	3.0	14.2	13.8
					LL	8	8	2	3.3-7.7	5.6	3.3	0.8
					RB	3	3	0	4.1-11.9	7.7	1.2	0.0
	3.9	15N, 11W, 35B	01-Aug-96	540	CT	1	1	0	7.9	7.9	0.2	0.0
					EB	14	13	0	6.7-9.8	7.8	2.4	0.0
					LL	4	3	0	6.4-7.5	7.1	0.6	0.0
					RB	2	2	0	5.3, 7.1	6.3	0.4	0.0
	5.7	15N, 11W, 35BC	30-Jun-94	375	CT	1	1	0	13.0	13.0	0.3	0.0
					EB	1	1	0	6.8	6.8	0.3	0.0
					RB	1	1	0	4.4	4.4	0.3	0.0

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number 1st Pass	YOY 1st Pass	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
Rock Creek (cont'd)	6.4	15N, 11W, 24D	31-Jun-94	510	EB	6	6	0	5.7-10.2	7.3	1.2	0.0
					LL	1	1	0	6.9	6.9	0.2	0.0
			01-Aug-96	565	CT	9	7	0	4.7-7.1	6.2	1.2	0.0
					EB	17	12	0	5.1-11.0	7.2	2.1	0.0
					SCUL	Uncommon						
	7.4	15N, 10W, 19B	30-Jun-94	543	CT	15	15	1	2.5-11.2	5.4	2.8	0.2
					EB	9	9	0	5.3-11.4	7.8	1.7	0.0
					SCUL	Common						
	7.5	15N, 10W, 19B	27-Aug-96	520	CT	9	9	8	2.1-7.1	2.7	1.7	1.5
					EB	27	17	1	1.7-10.1	7.3	3.3	0.2
					LND	Present						
					SCUL	Present						
Salmon Creek	0.2	15N, 10W, 18D	01-Jul-94	190	EB	7	7	6	2.2-5.9	2.9	3.7	3.2
					LND	5	5	0	1.6-3.0	2.1	2.6	0.0
	0.4	15N, 10W, 17B	01-Jul-94	300	CT	1	1	0	8.0	8.0	0.3	0.0
					EB	11	11	0	5.3-8.5	7.1	3.7	0.0
	1.3	15N, 11W, 13A	22-Jun-95	510	DV	2	2	0	6.7-6.9	6.9	0.4	0.0
					EB	27	27	6	1.6-6.1	4.3	5.3	1.2
					SCUL	Common						
	1.9	15N, 11W, 12D	23-Jun-95	513	CT	4	4	1	2.5-6.1	4.8	0.8	0.2
					EB	11	11	1	2.2-6.7	5.4	2.1	0.2
ditch @ mile 1.1	0.0	15N, 10W, 18B	22-Jun-95	261	EB	57	57	28	1.5-7.2	3.5	21.8	10.7
					LND	5	5	0	1.8-2.1	2.0	1.9	0.0
					SCUL	3	3	0	3.3-3.7	3.5	1.1	0.0
ditch @ mile 1.3	0.0	15N, 11W, 13A	23-Jun-95	231	EB	16	16	7	1.6-8.1	3.6	6.9	3.0
					LND	7	7	0	1.8-4.3	2.6	3.0	0.0
Shanley Creek	0.2	15N, 13W, 9B	11-Jun-93	360	CT	2	0	0	2.7-3.6	3.2	0.0	0.0
					EB	6	5	0	4.3-6.8	4.1	1.4	0.0
					LL	13	7	2	3.1-6.3	4.2	1.9	0.6
					SCUL	Common						
			31-Jul-96	300	CT	1	1	0	4.1	4.1	0.3	0.0
					EB	24	19	2	2.6-8.5	5.8	6.3	0.7
					LL	13	9	0	3.7-10.0	5.9	3.0	0.0
					SCUL	Common						
	1.4	15N, 13W, 3B	11-Jun-93	200	CT	8	7	0	4.3-6.8	5.8	3.5	0.0
					EB	21	18	8	2.3-7.0	4.3	9.0	4.0
					LL	1	1	0	5.7	5.7	0.5	0.0
	1.6	15N, 13W, 3B	31-Jul-96	466	CT	13	7	0	2.7-8.0	5.8	1.5	0.0
					EB	49	36	10	1.8-7.9	5.9	7.7	2.1
					LL	2	1	0	8.4, 9.0	8.9	0.2	0.0
					SCUL	Common						
Bandy ditch @ mile 1.6	0.2	15N, 13W, 3B	31-Jul-96	180	EB	8	8	8	1.8-2.1	2.2	4.4	4.4
			10-Jun-93	210	CT	4	4	0	4.0-7.9	5.8	1.9	0.0
					EB	7	7	3	2.7-6.8	4.2	3.3	1.4
Warren Creek	0.1	14N, 13W, 1B	11-Oct-91	186	LL	37	24	13	6.9-8.8	4.2	12.9	7.0
					RB	13	11	3	2.4-7.9	5.9	5.9	1.6
	0.4	14N, 13W, 1A	11-Oct-91	180	MWF	58	48	0	3.2-4.5	3.9	25.8	0.0
					EB	3	2	1	3.9-7.9	5.9	1.1	0.6
					LL	40	33	2	3.0-14.3	6.7	6.6	0.4
					RB	5	4	3	2.4-5.7	4.0	2.2	1.7
					LNS	1	0	0	6.4	6.4	0.0	0.0
					LSS	1	1	0	7.3	7.3	0.6	0.0
					MWF	13	10	0	3.8-4.7	4.3	5.6	0.0
	1.1	15N, 12W, 31C	06-May-92	273	EB	9	8	0	5.3-9.4	6.5	2.9	0.0
					LL	16	10	0	4.3-14.6	7.4	3.7	0.0
					RB	2	1	0	4.6-5.5	5.1	0.4	0.0
					LNS	3	2	0	4.5-6.1	5.5	0.7	0.0
	3.6	15N, 12W, 32C	18-Apr-94	400	EB	8	8	0	4.4-9.9	6.1	2.0	0.0
					LNS	1	1	0	6.2	6.2	0.3	0.0
	4.9	15N, 12W, 33D	18-Apr-94	450	EB	6	6	0	7.4-8.7	8.4	1.3	0.0
	8.2	15N, 12W, 25C	25-Jul-95	420	CT	1	1	0	8.8	8.8	0.2	0.0
					EB	37	25	5	2.8-10.2	7.4	6.0	1.2
					LNS	10	-	-	2.4-6.9	4.6	0.0	0.0
Wasson Creek	0.1	13N, 11W, 11D	15-Aug-91	400	CT	5	3	0	7.1-9.8	8.4	0.8	0.0
					LL	20	18	10	2.5-14.8	7.8	4.5	2.5
	0.6	13N, 11W, 13B	21-Aug-91	330	CT	7	7	0	6.0-9.6	8.6	2.1	0.0
					LL	4	4	1	3.1-15.4	10.1	1.2	0.3
	0.9	13N, 11W, 13B	21-Aug-91	200	CT	1	1	0	4.1	4.1	0.5	0.0
	2.4	13N, 10W, 7C	21-Aug-91	129	CT	28	25	13	1.4-4.9	3.8	19.4	10.1
	2.9	13N, 10W, 7D	21-Aug-91	135	CT	41	36	18	1.0-6.3	4.0	26.7	13.3
West Twin Creek	0.1	13N, 17W, 2	21-Aug-96	65	CT	1	1	0	6.8	6.8	1.5	0.0
					EB	1	1	1	3.2	3.2	1.5	1.5
					LL	1	1	1	2.0	2.0	1.5	1.5
					RB	2	2	2	1.7-3.1	2.4	3.1	3.1
	0.2	13N, 17W, 2	21-Aug-96	385	CT	2	2	1	3.0-4.0	3.6	0.5	0.3
					CT*	15	15	9	2.7-7.5	4.2	3.9	2.3

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	CPUE (#/100' in 1st Pass)	YOY CPUE (#/100' in 1st Pass)
						1st Pass	1st Pass	(in)	(in)	in 1st Pass	in 1st Pass	
West Twin Creek (cont')	0.2	13N, 17W, 2	21-Aug-96	385	EB	5	5	1	3.8-8.8	6.2	1.3	0.3
					RB	6	6	4	3.0-5.5	4.0	1.6	1.0
					SCUL	Present						
	1.0	14N, 17W, 34;	21-Aug-96	360	CT*	4	4	3	3.0-3.3	3.6	1.1	0.8
		14N, 17W, 35			EB	10	10	1	3.7-7.5	5.1	2.8	0.3
					RB	7	7	5	2.7-4.8	3.5	1.9	1.4
					LND	Present						
					SCUL	Present						
Willow Creek	1.7	14N, 9W, 28A	18-Aug-92	200	LL	4	4	0	2.4-13.4	7.7	2.0	0.0
	5.6	13N, 9W, 10B	18-Aug-92	100	CT	18	18	6	2.8-5.9	4.4	18.0	6.0
					EB	9	9	2	2.1-6.0	4.2	9.0	2.0
Yourname Creek	1.8	13N, 12W, 10B	17-Aug-92	150	CT	45	39	23	2.4-7.0	3.8	26.0	15.3

* Sample may include rainbow trout/cutthroat trout hybrids

Exhibit B. Mark-recapture population estimates in the Blackfoot River drainage, 1985 to 1996.

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Size Class (in)	Species	Marked	Captured	Recaptured	Efficiency (R/C)	Total Estim ± CI	Estim/1000 ± CI
Blackfoot River, Johnsrud Section	13.5	13N, 16W, 6	29-May-85	19008	CT	>6.0	58	56	16	0.28	197 ± 78	10.4 ± 4.0
					DV	>6.0	16	8	1	0.06	76 ± 77	4.0 ± 4.0
					LL	>6.0	22	14	2	0.09	114 ± 102	6.0 ± 5.3
					RB	5.0-10.0	470	448	60	0.13	3466 ± 818	182.3 ± 42.2
						10.0-12.0	122	95	15	0.12	737 ± 326	38.8 ± 16.8
						>12.0	78	53	6	0.08	608 ± 401	32.0 ± 20.7
					All	>5.0	766	674	100	0.13	5125 ± 936	269.6 ± 48.3
			23-May-89	19008	CT	>6.0	13	6	2	0.15	32 ± 24	1.7 ± 1.2
					DV	>6.0	16	12	7	0.44	27 ± 11	1.4 ± 0.6
					LL	>6.0	43	35	12	0.28	121 ± 52	6.4 ± 2.7
					RB	5.0-10.0	436	392	50	0.11	3366 ± 871	177.1 ± 44.9
						10.0-12.0	68	53	6	0.09	531 ± 350	28.0 ± 18.1
						>12.0	60	42	10	0.17	237 ± 118	12.5 ± 6.1
			07-Jun-90	19008	All	>5.0	636	540	87	0.14	3915 ± 760	206.0 ± 39.2
					CT	>6.0	19	30	8	0.42	68 ± 36	3.6 ± 1.9
					DV	>6.0	13	13	3	0.23	48 ± 36	2.5 ± 1.9
					LL	>6.0	46	53	14	0.30	168 ± 71	8.8 ± 3.7
					RB	5.0-10.0	424	482	94	0.22	2160 ± 395	113.6 ± 20.4
						10.0-12.0	148	120	34	0.23	514 ± 144	27.0 ± 7.4
						>12.0	59	48	15	0.25	183 ± 73	9.6 ± 3.8
			21-May-91	19008	All	>5.0	709	746	168	0.24	3137 ± 423	165.1 ± 21.8
					CT	>6.0	22	48	4	0.18	224 ± 174	11.8 ± 9.0
					DV	>6.0	17	17	3	0.18	80 ± 63	4.2 ± 3.3
					LL	>6.0	49	43	10	0.20	199 ± 100	10.5 ± 5.1
					RB	5.0-10.0	322	357	56	0.17	2028 ± 488	106.7 ± 25.2
						10.0-12.0	102	199	51	0.50	395 ± 93	20.8 ± 4.8
						>12.0	112	144	28	0.25	564 ± 184	29.7 ± 9.5
			18-May-93	19008	All	>5.0	624	808	152	0.24	3304 ± 479	173.8 ± 24.7
					CT	>6.0	39	42	8	0.21	190 ± 107	10.0 ± 5.5
					DV	>6.0	10	11	2	0.20	43 ± 37	2.3 ± 1.9
					LL	>6.0	65	87	16	0.25	341 ± 144	17.9 ± 7.4
					RB	5.0-10.0	228	239	37	0.16	1445 ± 425	76.0 ± 21.9
						10.0-12.0	140	85	21	0.15	550 ± 198	28.9 ± 10.2
						>12.0	105	89	16	0.15	560 ± 238	29.5 ± 12.3
			17-May-96	16005	All	>5.0	587	553	100	0.17	3224 ± 577	169.6 ± 29.8
					CT	>6.0	13	16	3	0.23	59 ± 46	3.7 ± 2.8
					DV	>6.0	9	6	4	0.44	13 ± 6	0.8 ± 0.3
					LL	>6.0	54	31	10	0.19	159 ± 74	9.9 ± 4.6
					RB	5.0-10.0	95	89	18	0.19	454 ± 180	28.3 ± 11.0
						10.0-12.0	29	33	18	0.62	53 ± 16	3.3 ± 1.0
						>12.0	43	57	12	0.28	195 ± 92	12.2 ± 5.6
					All	>5.0	243	232	65	0.27	860 ± 178	53.8 ± 10.9
Blackfoot River, Scotty Brown Bridge Section	43.9	15N, 13W, 32	25-May-89	20064	CT	6.0-12.0	8	12	1	0.13	58 ± 61	2.9 ± 3.0
						>12.0	0	0	0	—	—	—
					DV	>6.0	13	9	2	0.15	46 ± 38	2.3 ± 1.9
					LL	6.0-12.0	46	37	4	0.09	356 ± 271	17.8 ± 13.2
						>12.0	28	23	5	0.18	115 ± 75	5.7 ± 3.7
					RB	4.0-11.0	106	102	18	0.17	579 ± 234	28.9 ± 11.4
						11.0-14.0	25	27	6	0.24	103 ± 63	5.1 ± 3.1
						>14.0	16	13	4	0.25	47 ± 31	2.3 ± 1.5
					All	>6.0	242	223	40	0.17	1327 ± 370	66.1 ± 18.1
			05-Jun-90	20064	CT	6.0-12.0	21	46	5	0.24	171 ± 121	8.5 ± 5.9
					CT	>12.0	6	8	2	0.33	20 ± 16	1.0 ± 0.8
					DV	>6.0	6	12	2	0.33	29 ± 26	1.5 ± 1.3
					LL	6.0-12.0	27	44	6	0.22	179 ± 116	8.9 ± 5.7
						>12.0	29	26	10	0.34	73 ± 32	3.6 ± 1.6
					RB	4.0-11.0	123	209	30	0.24	839 ± 274	41.8 ± 13.4
						11.0-14.0	56	60	12	0.21	266 ± 126	13.3 ± 6.2
						>14.0	24	18	3	0.13	118 ± 94	5.9 ± 4.6
					All	>6.0	292	423	70	0.24	1749 ± 376	87.2 ± 18.4
			28-May-91	20064	CT	6.0-12.0	35	27	8	0.23	111 ± 58	5.5 ± 2.8
						>12.0	11	8	3	0.27	26 ± 17	1.3 ± 0.8
					DV	>6.0	15	8	3	0.20	35 ± 23	1.7 ± 1.1
					LL	6.0-12.0	31	28	6	0.19	132 ± 81	6.6 ± 4.0
						>12.0	31	37	11	0.35	100 ± 46	5.0 ± 2.2
					RB	4.0-11.0	101	106	15	0.15	681 ± 305	33.9 ± 14.9
						11.0-14.0	88	84	18	0.20	397 ± 157	19.8 ± 7.6
						>14.0	53	47	11	0.21	215 ± 103	10.7 ± 5.0
					All	>6.0	365	345	75	0.21	1665 ± 335	83.0 ± 16.4
			16-May-93	20064	CT	6.0-12.0	16	29	3	0.19	127 ± 105	6.3 ± 5.1
						>12.0	19	29	4	0.21	119 ± 89	5.9 ± 4.3
					DV	>6.0	16	13	3	0.19	59 ± 44	2.9 ± 2.2
					LL	6.0-12.0	17	28	1	0.06	260 ± 290	13.0 ± 14.1
						>12.0	50	30	14	0.28	104 ± 38	5.2 ± 1.8
					RB	4.0-11.0	33	62	3	0.09	535 ± 463	26.6 ± 22.6
						11.0-14.0	77	69	18	0.23	286 ± 109	14.3 ± 5.3
						>14.0	90	65	18	0.20	315 ± 119	15.7 ± 5.8
					All	>6.0	318	325	64	0.20	1599 ± 352	79.7 ± 17.2

Stream	River Mile Mid-point	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class (in)	Marked	Captured	Recaptured	Efficiency (R/C)	Total Estim	± CI	Estim/1000 ± CI
Blackfoot River,	43.9	15N, 13W, 32	15-May-96	20064	CT	6.0-12.0	30	24	6	0.20	110	± 66	5.5 ± 3.2
Scotty Brown Bridge Section (cont'd)					DV	>12.0	21	19	2	0.10	146	± 134	7.3 ± 6.6
					LL	6.0-12.0	20	11	0	0.00			2.6 ± 2.7
					RB	>12.0	39	37	10	0.26	137	± 67	6.8 ± 3.3
					RB	4.0-11.0*	42	48	9	0.21	210	± 113	10.5 ± 5.5
					RB	11.0-14.0*	19	20	4	0.21	83	± 59	4.1 ± 2.9
					RB	>14.0*	51	40	9	0.18	212	± 111	10.6 ± 5.4
					All	>6.0	230	210	41	0.18	1160	± 316	57.8 ± 15.5
Gold Creek	0.2	14N, 16W, 31	05-Aug-96	592	RB	<4.0	18	10	6	0.33	30	± 13	5.0 ± 2.1
					RB	>4.0	23	6	2	0.09	56	± 42	9.5 ± 7.1
					All	41	16	8	0.20	78	± 32	13.4 ± 5.8	
					LL	<4.0	15	38	2	0.13	208	± 1200	35.1 ± 33.7
					LL	>4.0	19	20	8	0.42	47	± 22	7.9 ± 3.8
					All	34	58	10	0.29	188	± 98	31.7 ± 16.5	
					RB & LL	>4.0	42	26	10	0.24	105.5	± 47	17.8 ± 7.9
					All	>4.0	43	29	10	0.23	120.0	± 55	20.3 ± 9.3
North Fork Blackfoot River	4.0	14N, 11W, 6A; 12W, 14N, 10D	29-Aug-89	20430	CT	>8.0	8	5	2	0.25	17	± 12	0.83 ± .6
					DV	6.0-12.0	5	3	0	0.00			
					DV	12.1-24.0	9	10	5	0.56	17	± 9	0.8 ± .4
					DV	>6.0	14	13	5	0.36	34	± 19	1.7 ± .9
					LL	6.0-12.0	26	36	5	0.19	165	± 114	8.1 ± 5.5
					LL	12.1-24.0	33	20	7	0.21	88	± 46	4.3 ± 2.2
					LL	>6.0	59	56	12	0.20	262	± 123	12.8 ± 5.9
					RB	6.0-12.0	17	12	2	0.12	77	± 67	3.8 ± 3.2
					RB	12.1-24.0	7	4	1	0.14	19	± 17	0.9 ± 0.8
					RB	>6.0	24	16	3	0.13	105	± 82	5.2 ± 3.9
					All	>6.0	105	90	22	0.21	418	± 148	20.5 ± 7.1
			21-Aug, 04-Sep-90	20430	CT	>8.0	13	12	4	0.31	35	± 23	1.7 ± 1.1
					DV	6.0-12.0	11	5	0	0.00			
					DV	12.1-24.0	18	8	4	0.22	33	± 18	1.6 ± 0.9
					DV	>6.0	29	13	4	0.14	83	± 54	4.1 ± 2.6
					LL	6.0-12.0	79	55	5	0.06	746	± 533	36.5 ± 25.5
					LL	12.1-24.0	46	39	10	0.22	170	± 84	8.3 ± 4.0
					LL	>6.0	125	94	15	0.12	747	± 330	36.6 ± 15.9
					RB	6.0-12.0	36	33	3	0.08	314	± 263	15.3 ± 12.6
					RB	12.1-24.0	8	9	0	0.00			
					RB	>6.0	44	42	3	0.07	483	± 411	23.6 ± 19.7
					All	>6.0	211	161	26	0.12	1271	± 439	62.2 ± 21.0
			28-Aug, 10-Sep-91	20430	CT	>8.0	15	4	2	0.13	26	± 16	1.3 ± 0.8
					DV	6.0-12.0	11	6	1	0.09	41	± 40	2.0 ± 1.9
					DV	12.1-24.0	24	3	2	0.08	32	± 16	1.6 ± 0.8
					DV	>6.0	35	9	3	0.09	89	± 62	4.4 ± 3.0
					LL	6.0-12.0	33	15	2	0.06	180	± 163	8.8 ± 7.8
					LL	12.1-24.0	90	51	14	0.16	314	± 133	15.4 ± 6.4
					LL	>6.0	123	66	16	0.13	488	± 199	23.9 ± 9.5
					RB	6.0-12.0	25	28	1	0.04	376	± 419	18.4 ± 20.1
					RB	12.1-24.0	20	7	3	0.15	41	± 26	2.0 ± 1.2
					RB	>6.0	45	35	4	0.09	330	± 250	16.2 ± 12.0
					All	>6.0	218	114	25	0.11	968	± 328	47.4 ± 15.7
			23-Aug, 02-Sep-94	20430	CT	>8.0	9	4	0	0.00			
					DV	6.0-12.0	5	6	1	0.20	20	± 20	1.0 ± 0.9
					DV	12.1-24.0	28	10	5	0.18	52	± 27	2.6 ± 1.3
					DV	>6.0	33	16	6	0.18	82	± 44	4.0 ± 2.1
					LL	6.0-12.0	23	11	4	0.17	57	± 35	2.8 ± 1.7
					LL	12.1-24.0	64	58	22	0.34	166	± 53	8.1 ± 2.5
					LL	>6.0	87	69	26	0.30	227	± 67	11.1 ± 3.2
					RB	6.0-12.0	12	5	1	0.08	38	± 36	1.9 ± 1.7
					RB	12.1-24.0	12	5	2	0.17	25	± 18	1.2 ± 0.8
					RB	>6.0	24	10	3	0.13	68	± 48	3.3 ± 2.3
					All	>6.0	153	99	35	0.23	427	± 112	20.9 ± 5.4
			28-Aug-96	20430	CT	>8.0	17	9	4	0.24	35	± 20	1.7 ± 1.0
					DV	6.0-12.0	5	3	0	0.00			
					DV	12.1-24.0	18	6	3	0.17	32	± 19	1.6 ± 0.9
					DV	>6.0	23	9	3	0.13	59	± 41	2.9 ± 2.0
					LL	6.0-12.0	22	24	3	0.14	143	± 117	7.0 ± 5.6
					LL	12.1-24.0	43	25	5	0.12	190	± 126	9.3 ± 6.0
					LL	>6.0	65	49	8	0.12	366	± 209	17.9 ± 10.0
					RB	6.0-12.0	22	8	2	0.09	68	± 56	3.3 ± 2.7
					RB	12.1-24.0	8	5	3	0.38	13	± 6	0.6 ± 0.3
					RB	>6.0	30	13	5	0.17	71	± 41	3.5 ± 2.0
					All	>6.0	135	80	20	0.15	524	± 192	25.6 ± 9.2

Exhibit C. Summary of two and three pass population estimates in the Blackfoot River drainage, 1990 to 1996.

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class (in)	Prob. of Capture			Total Estimate ± CI	Total Estimate ± CI
							1st Pass	2nd Pass	3rd Pass		
Arrastra Creek	0.7	14N, 10W, 29	26-Aug-96	440	CT	3.0-8.5	14	6	2	0.57	24.5 ± 11.5
					EB	>4.0	9	3	3	0.67	16 ± 4.5
					LL	2.0-7.0	43	30	14	0.30	98 ± 12
	2.4	14N, 10W, 17D	28-Aug-96	200	CT	1.7-10.9	8	3	-	0.63	12.8 ± 6.2
					DV	7.50	1	0	-	1.00	-
					EB	2.5-9.7	34	22	-	0.35	96.3 ± 76.2
Basin Creek					LL	4.9-10.0	12	4	-	0.67	18.0 ± 5.9
	0.7	15N, 13W, 33B	05-Sep-91	270	EB	<4.0	34	5	-	0.85	39.9 ± 2.5
					>4.0		11	3	-	0.73	15.1 ± 3.8
Bear Creek	1.1	3N, 16W, 18B, 7C	20-Jun-94	345	LNS	4.1-7.2	23	13	-	0.43	52.9 ± 35.2
					EB	4.2-5.7	5	1	-	0.80	6.2 ± 1.5
					LL	3.8-8.5	5	2	-	0.60	8.3 ± 5.8
	1.5	13N, 16W, 13B	25-Jul-95	300	RB	2.4-4.0	8	4	-	0.50	16.0 ± 13.6
					EB	<4.0	10	5	-	0.50	20.0 ± 15.2
					>4.0		8	3	-	0.63	12.8 ± 6.2
					All	18	8	-	0.56	32.4 ± 14.4	
					RB	<4.0	3	2	-	0.33	9.0 ± 26.3
					>4.0		11	2	-	0.82	13.4 ± 1.9
					All	14	4	-	0.71	19.6 ± 4.7	
Belmont Creek	1.8	13N, 17W, 13D	20-Jun-94	210	EB	3.6-7.0	11	2	-	0.82	13.4 ± 1.9
					RB	3.0-5.4	9	5	-	0.44	20.3 ± 20.6
					DV	>4.0	3	1	-	0.80	4.5 ± 2.9
	0.6	14N, 16W, 24B	15-Sep-94	360	LL	<4.0	9	5	-	0.61	20.2 ± 20.6
					>4.0		19	7	-	0.70	30.1 ± 9.2
Blanchard Creek	0.1	14N, 14W, 5A	22-Aug-90	310	RB	<4.0	39	5	-	0.87	44.7 ± 2.2
					>4.0		11	4	-	0.64	17.3 ± 6.8
			14-Sep-95	420	LL	2.8-7.2	11	5	-	0.55	20.2 ± 12.0
					RB	<4.0	108	40	-	0.63	171.5 ± 22.3
					>4.0		38	9	-	0.76	49.8 ± 5.5
Chamberlin Creek	0.1	15N, 13W, 32	12-Sep-95	282	CT*	<4.0	39	10	-	0.74	52.4 ± 6.4
					>4.0		29	3	-	0.90	32.3 ± 1.4
					LL	<4.0	25	12	-	0.52	48.1 ± 21.2
					>4.0		7	1	-	0.86	8.2 ± 1.1
	0.5	15N, 13W, 3D	12-Sep-95	336	CT*	<4.0	33	15	-	0.55	60.5 ± 20.7
Cottonwood Creek					>4.0		25	9	-	0.64	39.1 ± 10.0
	4.7	15N, 13W, 8D	28-Jul-92	240	LL	<4.0	14	2	-	0.86	16.3 ± 1.5
					4.0-8.0		40	8	-	0.80	50 ± 4.2
					>8.0		15	7	-	0.53	28.1 ± 15.1
	5.5	15N, 13W, 8D	28-Jul-92	300	LL	4.0-8.0	21	12	-	0.43	49.0 ± 35.0
Big Spring Creek					>8.0		24	12	-	0.50	48.0 ± 23.5
	7.5	15N, 13W, 5C	23-Jul-91	285	CT	>3.5	3	1	2	0.54	6.0 ± 3.5
					EB	<4.0	57	41	14	0.47	131 ± 20
					>4.0		22	11	4	0.60	39.0 ± 5.3
					LL	<4.0	27	15	12	0.38	71 ± 26
Dunham Creek	0.1	15N, 13W, 5D	07-Nov-91	231	LL	>3.3	29	9	-	0.69	42.1 ± 7.9
	2.3	16N, 12W, 19B	07-Aug-96	400	CT	<4.0	6	4	-	0.33	18.0 ± 37.2
					>4.0		7	1	-	0.86	8.2 ± 1.1
					2.4-16.4		13	5	-	0.62	21.1 ± 8.4
					DV	>6.0	4	1	-	0.75	5.3 ± 1.9
Elk Creek	4.2	16N, 13W, 12D	07-Aug-96	655	CT	3.6-6.9	2	1	-	0.50	4.0 ± 6.8
	0.1	14N, 15W, 26D	03-Oct-91	198	RB	2.0-4.5	6	2	-	0.67	9.0 ± 4.2
			25-Sep-96	355	LL	4.0	1	0	-	1.00	-
					RB	2.4-8.5	11	5	-	0.55	20 ± 12
	1.1	14N, 15W, 36A	03-Oct-91	186	RB	2.2-9.6	15	7	-	0.53	28.1 ± 15.1
Cottonwood Creek			25-Sep-96	350	RB	2.5-6.0	3	0	-	1.00	3.0 ± 0.0
					6.0-11.0	6	0	-	1.00	6.0 ± 0.0	
	2.3	14N, 14W, 31B	14-Sep-95	375	EB	>4.0	2	0	-	1.00	2.0 ± 0.0
					RB	>4.0	2	0	-	1.00	2.0 ± 0.0
			25-Sep-96	380	CT	8.5, 9.5	2	0	-	1.00	2.0 ± 0.0
Big Spring Creek					RB	2.4-10.5	22	9	-	0.59	37.2 ± 12.8
					10.5	1	0	-	1.00	1.0 ± 0.0	
	3.0	14N, 14W, 32	03-Oct-91	108	EB	2.6-9.6	30	15	-	0.50	60.0 ± 26.3
					RB	1.8-8.5	45	18	-	0.60	75.0 ± 17.3
			25-Sep-96	385	EB	2.0-8.8	6	1	-	0.83	7 ± 1
Gold Creek					RB	1.0-6.9	40	25	-	0.38	106 ± 70
					RB	2.4-9.0	47	8	-	0.83	56.6 ± 3.6
	4.6	13N, 14W, 5D	03-Oct-91	105	EB	>4.0	5	0	-	1.00	5.0 ± 0.0
	2.5	14N, 16W, 30B	06-Aug-96	569	CT*	>4.0	3	0	-	1.00	3.0 ± 0.0
	2.7				DV	>4.0	3	0	-	1.00	0.5 ± 0.0
Elk Creek					LL	>4.0	32	6	-	0.81	39.4 ± 3.4
					All	<4.0	13	6	-	0.54	24.1 ± 13.6
					>4.0		50	17	-	0.66	75.8 ± 12.5
Big Spring Creek					>10.0		11	2	-	0.82	13.4 ± 1.9
									-	2.4 ± 0.3	

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class (in)	Prob. of Capture			Total Estimate ± CI	Total Estim./100' ± CI
							1st Pass	2nd Pass	3rd Pass		
Grantier Spring Creek	1.0	14N, 9W, 25A	02-Jul-91	700	EB	>4.0	42	22	-	0.48	88.2 ± 36.2
					LL	>4.0	52	26	-	0.50	104.0 ± 34.6
			25-Jul-94	258	EB	<4.0	65	33	23	0.29	147 ± 25.7
					LL	>4.0	9	3	2	0.67	14.0 ± 2.2
Hoyt Creek	0.2	15N, 12W, 19B	08-Sep-92	200	EB	>2.0	23	10	-	0.57	40.7 ± 15.3
					LL	>2.0	2	1	-	0.50	4.0 ± 6.8
					MWF	>2.0	20	8	-	0.60	33.3 ± 11.5
					RB	>2.0	13	7	-	0.46	28.2 ± 22.2
Kleinschmidt Creek	0.1	14N, 11W, 6A	26-Jul-94	100	LL	<4.0	78	48	42	0.29	262 ± 88
					RB	>4.0	1	0	0	1.00	1.0 ± 0.0
					RB	<4.0	12	3	3	0.67	16.0 ± 3.4
					LL	>4.0	11	3	-	0.73	15.1 ± 3.8
Lincoln Spring Creek	1.4	14N, 9W, 23B	20-Jul-95	360	LL	<4.0	25	9	-	0.64	39.1 ± 10.0
					LL	>4.0	14	7	-	0.50	28.0 ± 18.0
	2.1	14N, 9W, 23A	20-Jul-95	325	LL	>4.0	15	6	-	0.60	25.0 ± 10.0
					EB	>4.0	17	6	-	0.65	26.3 ± 7.9
McCabe Creek	2.5	15N, 12W, 5D	07-Nov-91	375	LL	>2.0	11	2	-	0.82	9.8 ± 3.3
					EB	>4.0	1	0	0	1.00	3.6 ± 0.5
					LL	>2.0	12	3	3	0.67	16.0 ± 3.4
					CT	1.6-11.7	49	12	-	0.76	64.9 ± 6.6
below culvert above culvert	2.5	15N, 12W, 5C	16-Sep-92	150	CT	1.6-6.2	28	3	-	0.89	31.4 ± 1.5
					CT	1.1-8.0	25	4	-	0.84	29.8 ± 2.4
	3.2	15N, 12W, 4C	16-Sep-92	150	CT	2.7-6.8	14	7	-	0.50	28.0 ± 18.0
					NSF	2.9-8.7	16	7	-	0.56	28.4 ± 13.0
Nevada Creek	0.7	13N, 11W, 7D	09-Sep-94	500	LSS	5.3-7.3	5	2	-	0.60	8.3 ± 5.8
					LSS	>4.0	43	4	-	0.91	47.4 ± 1.5
					RSS	2.4-4.3	16	8	-	0.50	32.0 ± 19.2
					RSS	1.0-3.4	11	7	-	0.36	30.3 ± 40.0
	12.5	13N, 11W, 23A	09-Sep-94	500	LSS	>4.0	3	1	-	0.67	4.5 ± 2.9
					CT*	7.0, 11.2	2	0	-	1.00	2.0 ± 0.0
					LNS	12.4-15.8	3	3	-	0.00	-
					LSS	2.9-17.0	39	15	-	0.62	63.4 ± 14.6
	25.7	12N, 10W, 5A	09-Aug-94	420	RSS	1.6-2.4	2	2	-	0.00	-
					SCUL	>1.0	59	12	-	0.80	74.1 ± 5.3
					EB	5.1-10.0	28	7	-	0.75	37.3 ± 5.2
					LNS	4.0	1	0	-	1.00	1.0 ± 0.0
Nevada Spring Creek	3.0	13N, 11W, 11D	26-Jul-90	2000	EB	<4.0	12	6	-	0.43	171.1 ± 64.1
					LL	>4.0	74	42	-	0.43	21.8 ± 7.4
					LL	<4.0	24	12	-	0.50	13.1 ± 0.7
					SCUL	1.6-4.5	79	62	-	0.22	15.8 ± 3.7
Rock Creek	0.1	14N, 11W, 6A	28-Jul-94	352	EB	>4.0	3	2	-	0.33	9.0 ± 26.3
					LL	>4.0	21	8	-	0.62	33.9 ± 10.5
					LL	<4.0	131	68	-	0.48	272.4 ± 62.1
					RB	>4.0	12	9	-	0.25	48.0 ± 107.8
Shanley Creek	0.7	14N, 11W, 5B	03-Aug-90	469	EB	<4.0	18	6	4	0.63	30 ± 3.8
					EB	>4.0	3	0	-	1.00	3.0 ± 0.0
					LL	<4.0	20	5	-	0.75	26.7 ± 4.4
					LL	>4.0	8	2	-	0.75	10.7 ± 2.8
	3.9	15N, 11W, 35B	01-Aug-96	540	EB	>4.0	133	45	-	0.66	201.0 ± 20.2
					RB	>4.0	6	2	-	0.67	9.0 ± 4.2
					EB	>4.0	13	1	-	0.92	14.1 ± 0.7
					LL	>4.0	3	1	-	0.67	4.5 ± 2.9
7.5	6.4	15N, 11W, 24D	01-Aug-96	565	EB	>4.0	7	2	-	0.71	9.8 ± 3.3
					EB	>4.0	12	5	-	0.58	20.6 ± 9.9
					CT	2.0-7.1	9	0	-	1.00	9.0 ± 0.0
					EB	>4.0	16	9	-	0.44	36.6 ± 28.8
	1.4	15N, 13W, 3B	11-Jun-93	360	EB	>4.0	5	1	-	0.80	6.3 ± 1.5
					LL	>4.0	5	2	-	0.60	8.3 ± 5.8
					A11	>4.0	10	3	-	0.70	14.3 ± 4.3
					EB	>4.0	17	5	-	0.71	24.1 ± 5.4
1.6	3.9	15N, 11W, 35B	31-Jul-96	300	EB	>4.0	9	3	-	0.67	13.5 ± 5.1
					LL	>4.0	26	8	-	0.69	37.6 ± 7.3
					CT	>4.0	7	1	-	0.86	8.2 ± 1.1
	1.4	15N, 13W, 3B	11-Jun-93	200	EB	<4.0	8	2	-	0.75	10.7 ± 2.8
					EB	>4.0	10	1	-	0.90	11.1 ± 0.8
					EB	>4.0	7	3	-	0.57	12.3 ± 8.1
	1.6	15N, 13W, 3B	31-Jul-96	466	EB	>4.0	24	5	-	0.79	30.3 ± 3.5
					EB	>4.0	-	-	-	6.5 ± 0.8	-

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class (in)	Prob.			Total Estimate ± CI	Total Estim/100' ± CI
							1st Pass	2nd Pass	3rd Pass		
Warren Creek	0.1	14N, 13W, 1B	11-Oct-91	186	LL	<4.0	13	8	-	0.38	33.8 ± 37.4
						>4.0	11	5	-	0.55	20.2 ± 12.0
						2.9-8.8	24	13	-	0.46	52.4 ± 30.7
					MWF	3.2-4.5	47	11	-	0.77	61.36 ± 6.0
	0.4	14N, 13W, 1A	11-Oct-91	180	RB	2.4-7.6	11	2	-	0.82	13.4 ± 1.9
						>4.0	8	2	-	0.75	10.7 ± 2.8
						3.0-14.3	30	5	-	0.83	36.0 ± 2.8
	8.2	15N, 12W, 25C	25-Jul-95	420	MWF	3.8-4.7	33	7	-	0.79	41.9 ± 4.2
					RB	2.9-5.7	10	3	-	0.70	14.3 ± 4.3
					EB	<4.0	4	1	-	0.75	5.3 ± 1.9
Wasson Creek	0.1	13N, 11W, 11D	25-Jul-90	980	CT	4-12.7	5	0	-	1.00	5.0 ± 0.0
					LL	2.9-13.1	12	2	-	0.83	4.0 ± 0.0
	2.9	13N, 10W, 7D	21-Aug-91	135	CT	<4.0	18	4	-	0.78	14.4 ± 1.8
Yourname Creek	1.8	13N, 12W, 10B	17-Aug-92	150	CT	>4.0	18	1	-	0.94	23.1 ± 3.4
						>4.0	25	2	-	0.71	19.1 ± 0.5
						>4.0	-	-	-	0.92	17.1 ± 0.4

* Sample may include rainbow trout/cutthroat trout hybrids

Exhibit D: Table of Restoration Streams and Activities.

Stream Name	Fish passage barrier removal	Prevent irrigation ditch losses	Critical habitat protection	Channel restoration	Improve fish habitat	Improve riparian vegetation	Improve stream flow	Improve wetlands	Improve range-riparian habitat	Improve livestock-irrigation system	Remove streamside feedlot
Bear	X	X	X	X	X			X	X	X	
Belmont	X		X					X			
Blanchard	X	X			X	X		X		X	
Chamberlain	X	X			X	X		X	X	X	
Cottonwood	X	X					X		X	X	X
Dick	X	X			X	X		X		X	X
Dunham				X						X	
Elk	X				X	X	X	X	X	X	
East Twin	X										
Gilbert - Rock Creek	X				X	X	X	X			
Gold	X				X						
Ganier	X				X	X	X	X	X	X	
Hoyt	X									X	
Kleinschmidt	X				X	X	X				
Monroe				X	X	X			X	X	
Nevada						X		X	X	X	
Nevada Spring					X	X		X	X	X	
North Fork Blackfoot		X		X	X	X	X	X	X	X	
O'Brien - Bitterroot	X			X	X	X	X		X	X	X
Pearson	X			X	X	X	X	X	X	X	
Plumont - Clark Fork	X				X	X	X				
Rock (Wyandot)	X	X			X	X	X	X	X	X	X
Salmon Creek	X	X	X		X	X	X	X	X	X	X
Shailey		X				X	X	X	X	X	
Warren	X						X		X	X	
West Twin	X										

Exhibit E: Table of Restoration Streams and Cooperators.

Stream Name	MT FW&P	USFWS Partners for Wildlife	BLM	US EPA	MT DEQ Water Qual. Division	North Powell Cons. District	Private Landowner	Big Blackfoot Chapter Trout Unlimited	National Fish & Wildlife Foundati on	Ducks Unlimit ed	MPC	DNRC	Dept. Of Tran	Plum Creek Timber Company
Bear	X	X				X	X			X				X
Belmont	X					X	X							X
Blanchard	X	X	X			X	X					X	X	
Chamberlain	X	X	X			X	X		X					X
Cottonwood	X	X	X			X								X
Dick	X	X				X	X	X	X					X
Dunham	X	X				X	X							
East Twin	X													X
Elk	X	X	X			X	X	X	X					
Gilbert - Rock Cr.	X	X				X								
Gold	X	X				X								X
Grantier	X	X				X	X							
Hoyt	X	X				X	X							
Kleinschmidt	X	X				X	X	X						
Monture	X	X				X	X	X						
Nevad■	X	X	X	X	X	X	X	X						
Nevada Spring	X					X	X							
North Fork Blackfoot	X	X				X	X							
O'Brien - Bitterroot	X	X				X								
Pearson	X	X				X	X							
Pimont - Cl. Fork	X					X								
Rock (Ovando)	X	X				X	X	X		X	X			
Salmon	X	X				X	X							
Shanley	X	X				X								
Warren	X	X				X								
West Twin	X	X												X

October 27, 1992

Don Peters
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Don:

We have completed the electrophoretic analysis of the char samples collected from Belmont Creek (October 16 and 18, 1991; N=15; T15N R16W S20c+28) and Cache Creek (October 9, 1991; N=2). Horizontal starch gel electrophoresis was used to determine each fishes genetic characteristics at 45 loci (genes) coding for proteins present in muscle, liver, or eye tissue (Table 1). At nine of these loci, the bull, Salvelinus confluentus, and brook trout, S. fontinalis rarely share alleles (form of a gene) in common (Table 2). Loci at which such distinctive genetic differences exist between taxa are commonly termed diagnostic loci because they can be used to determine the proportion of bull trout, brook trout, and their hybrids in a sample.

All of the fish in both samples possessed alleles characteristic of only bull trout at all diagnostic loci (Table 3). These fish, therefore, were certainly genetically pure bull trout.

We also analyzed adipose fins from char in Cache Creek (October 9, 1991; N=13) and Fish Creek section 1 (October 7, 1991; N=4) and section 2 (October 8, 1991; N=5). We were able to examine the products of four diagnostic loci between the bull and brook trout from the fins: LDH-B2*, sIDHP-2*, sMDH-A2*, and sSOD-1*. All of the fish in the Fish Creek and all but one from Cache Creek appeared to be pure bull trout. The remaining Cache Creek fish possessed both brook and bull trout alleles at all diagnostic loci analyzed indicating it is a hybrid between these fishes.

Sincerely,



Robb Leary

RL:ld

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REGION

Division of Biological Sciences
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April 16, 1996

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Montana Fish, Wildlife, and Parks
3201 Spurgin Road
Missoula, MT 59801

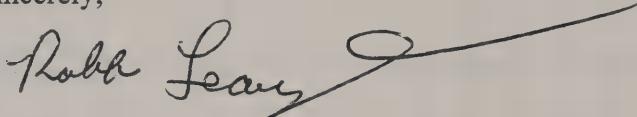
Don:

We have completed the electrophoretic analysis of the char collected from Copper Creek (October 27, 1995; N = 25) and North Fork Blackfoot River (September 3, 1995; N = 20). Horizontal starch gel electrophoresis was used to determine each fish's genetic characteristics at 45 loci (genes) coding for proteins present in muscle, liver, or eye tissue (Table 1). At nine of these loci, the bull, *Salvelinus confluentus*, and brook trout, *S. fontinalis*, rarely share alleles (form of a gene) in common (Table 2). These are commonly termed diagnostic loci because the alleles detected at them can be used to determine whether a fish was a bull trout, brook trout, or hybrid.

All the fish in both the samples had alleles at the diagnostic loci analyzed characteristic of only bull trout. Thus, all the fish in the samples were undoubtedly bull trout.

Evidence of genetic variation was detected at only two loci in the samples (Table 3). Contingency table chi square analysis did not indicate that the allele frequencies were statistically heterogenous between the samples at either locus (Table 3). Thus, there is no evidence that genetic differences exist between bull trout in Copper Creek and the North Fork Blackfoot River. This conclusion, however, must be considered tentative because with only two genetically variable loci our ability to detect genetic differences is very weak.

Sincerely,

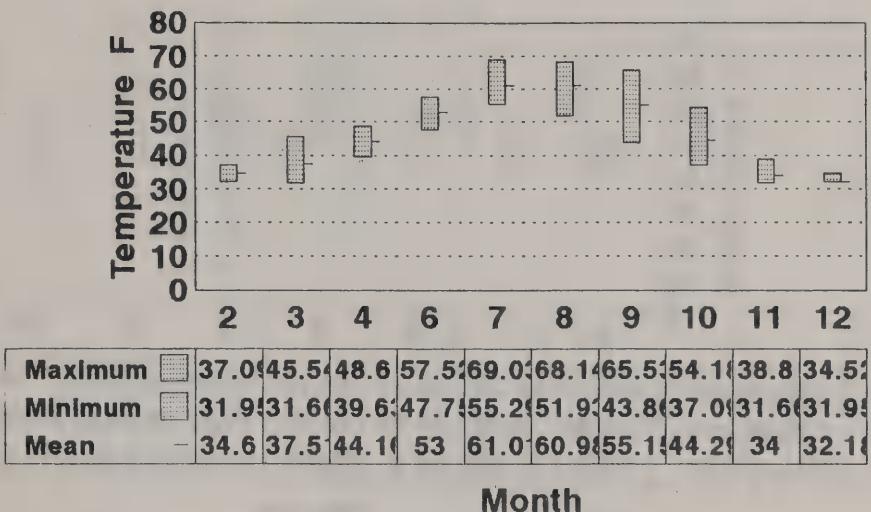


Robb Leary



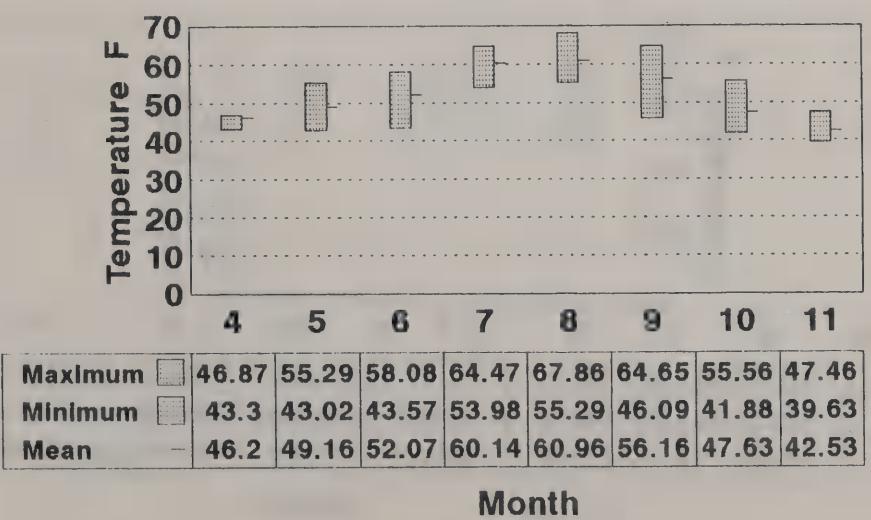
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Blackfoot River at Wisherd Bridge Water Temperature Summary



Period of Record 8\94 - 9\96

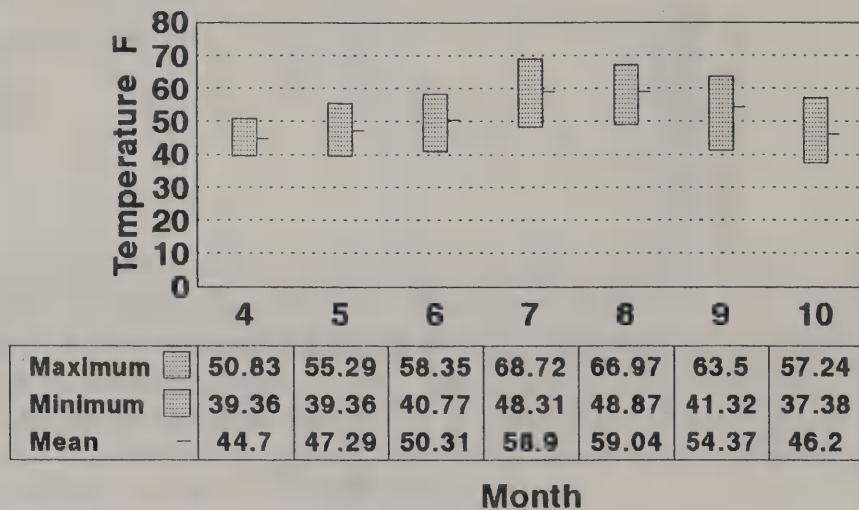
Blackfoot River at Belmont Creek Water Temperature Summary



Period of Record 8\94 - 7\96

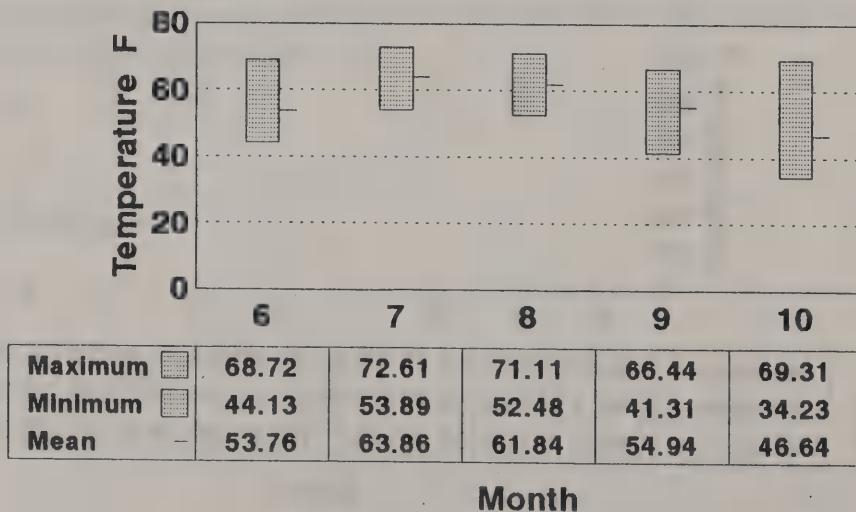
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Blackfoot River at Scotty Brown Bridge Water Temperature Summary



Period of Record 8/94 - 10/96

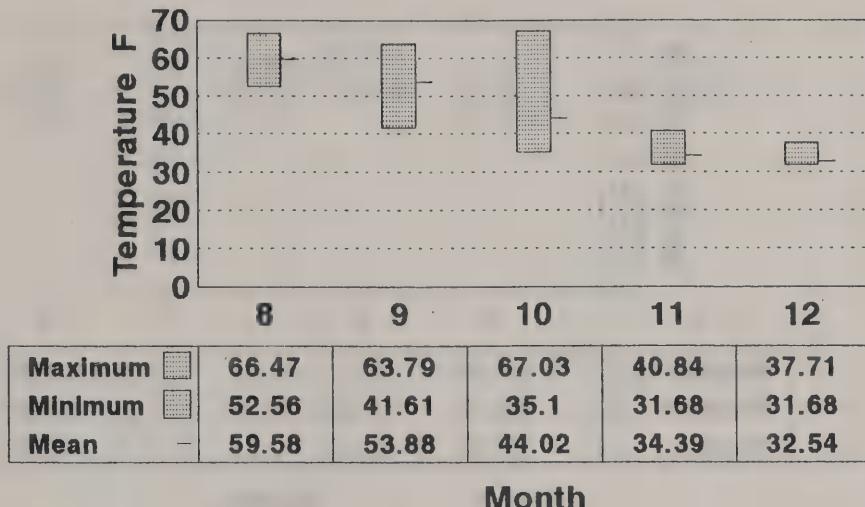
Blackfoot River at Raymond Bridge Water Temperature Summary



Period of Record 6/94 - 10/96

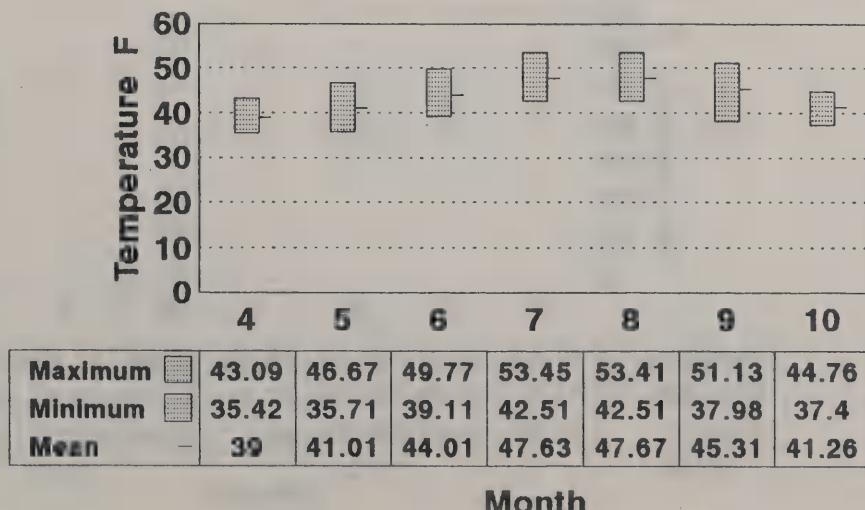
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Blackfoot River at Helmville Cutoff Bridge Water Temperature Summary



Period of Record 8/94 - 10/95

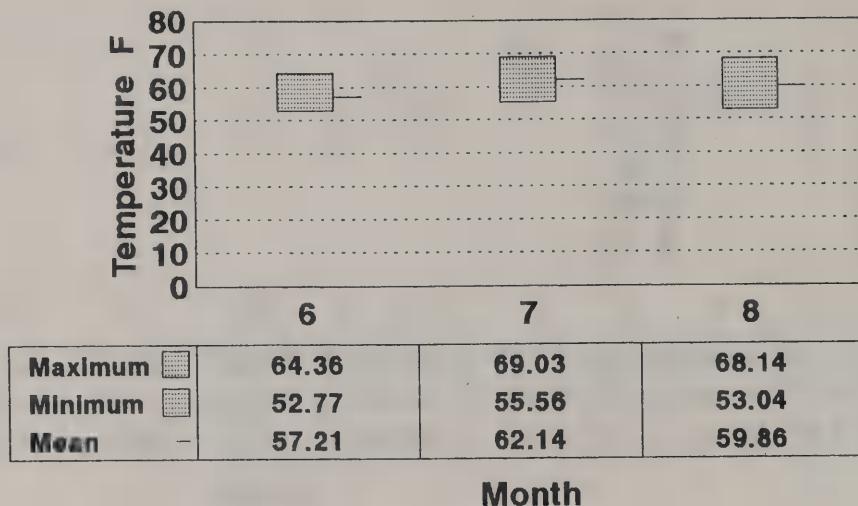
Gilbert Creek above Reservoir Water Temperature Summary



Period of Record 4/95 - 8/96

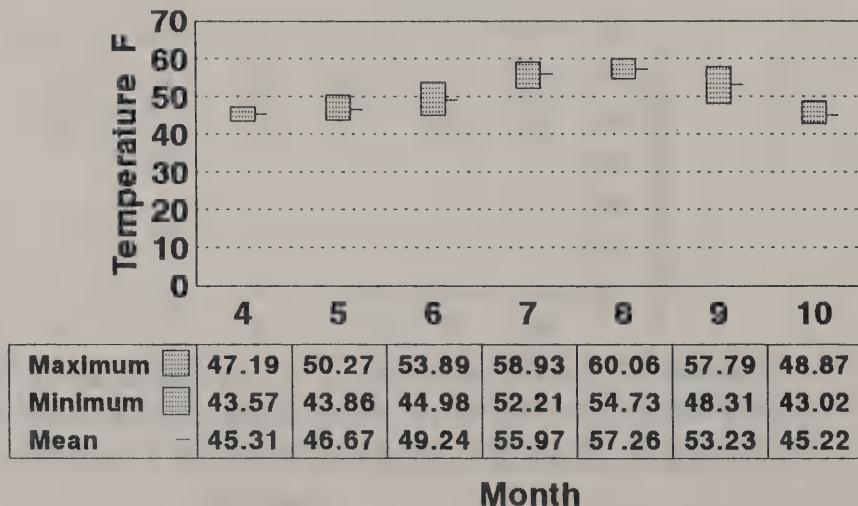
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Gilbert Reservoir - Surface Depth Water Temperature Summary



Period of Record 4\95 - 10/95

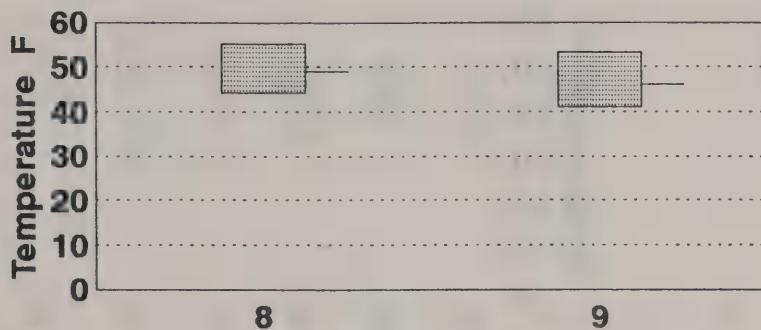
Gilbert Reservoir - 8 Ft Depth Water Temperature Summary



Period of Record 4\95 - 10/95

Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Landers Fork at Highway 200 Bridge Water Temperature Summary

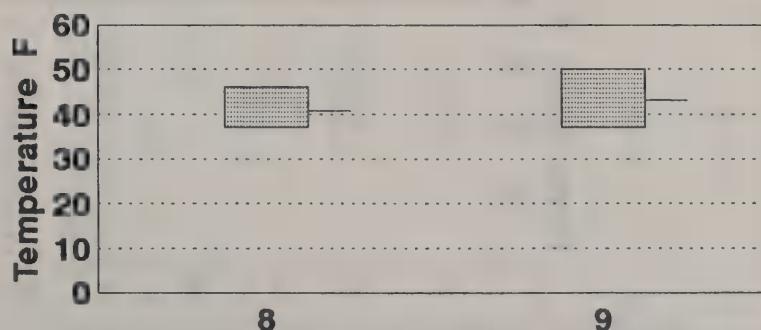


	8	9
Maximum	55	53.33
Minimum	44.13	41.05
Mean	48.98	46.18

Month

Period of Record 8/96 - 9/96

Landers Fork at Forest Service Bridge Water Temperature Summary



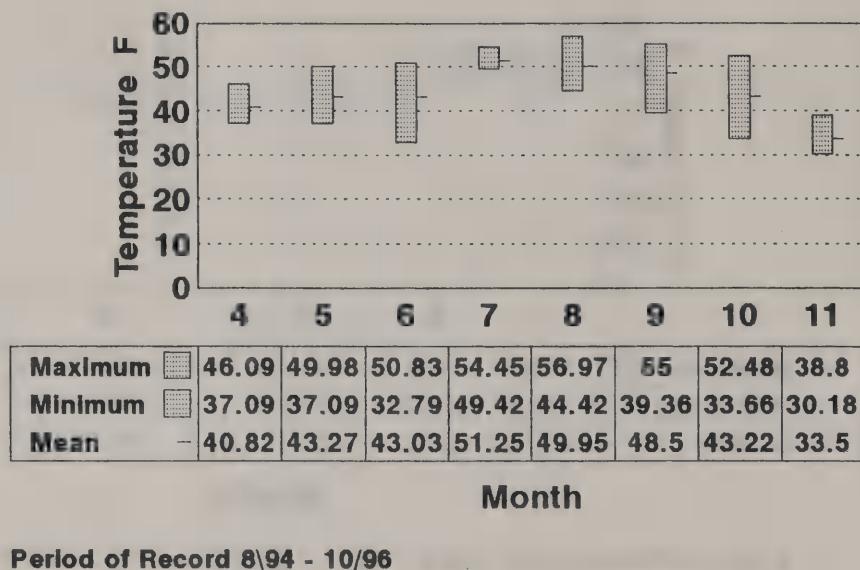
	8	9
Maximum	46.09	49.98
Minimum	37.09	37.09
Mean	40.82	43.27

Month

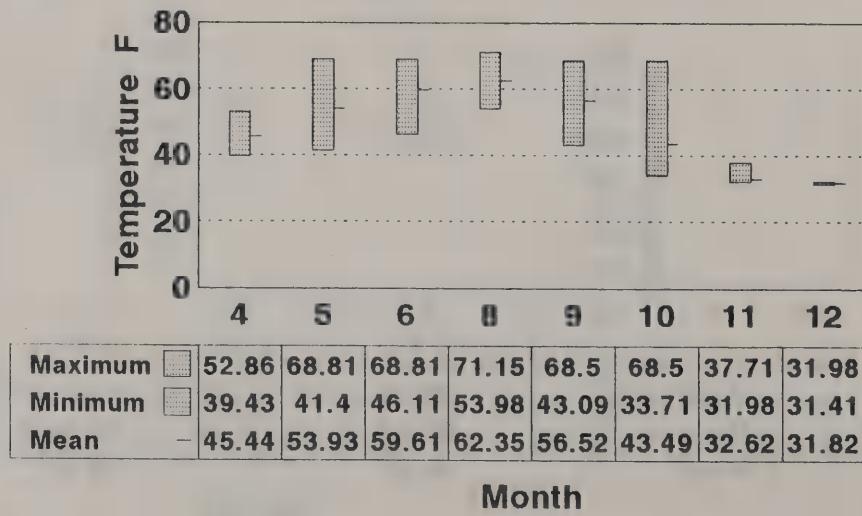
Period of Record 8/96 - 9/96

Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Johnson Creek at Mouth Water Temperature Summary



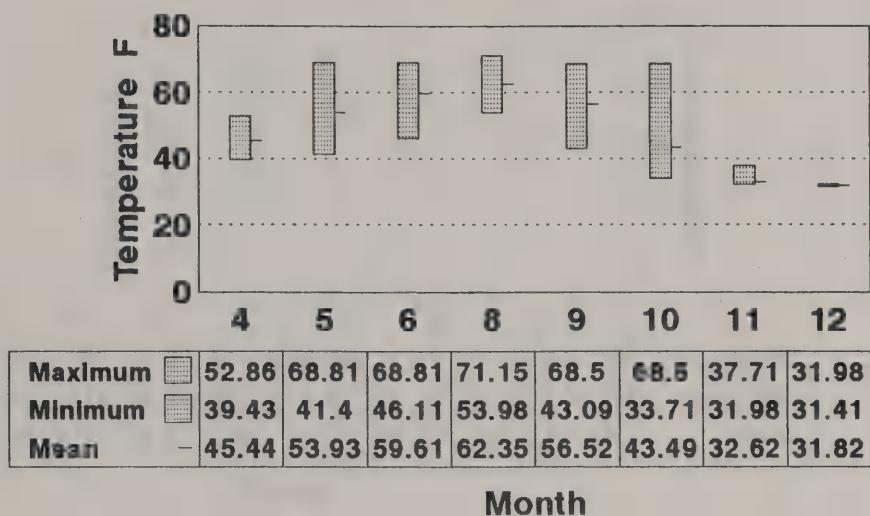
Nevada Creek at Mouth Water Temperature Summary



Period of Record 8/94 - 10/95

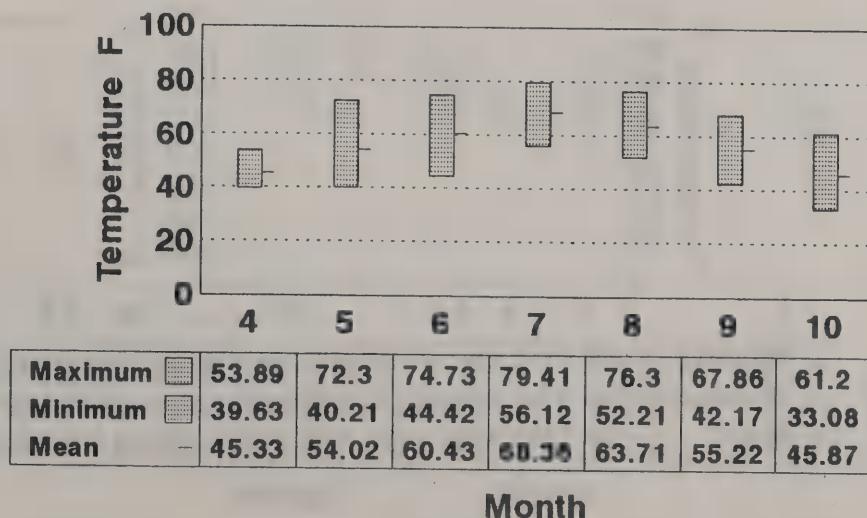
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Nevada Creek at Mouth Water Temperature Summary



Period of Record 8/94 - 7/96

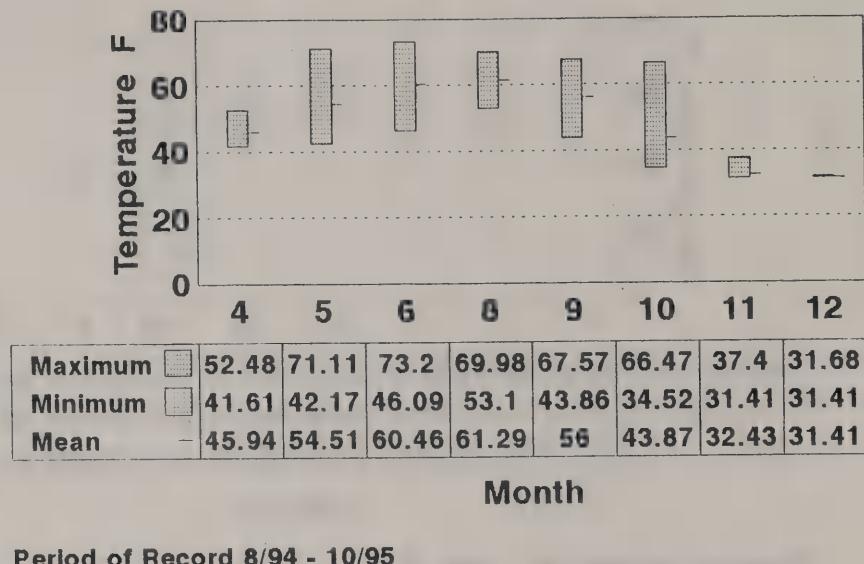
Nevada Creek Below Douglas Creek Water Temperature Summary



Period of Record 8/94 - 10/96

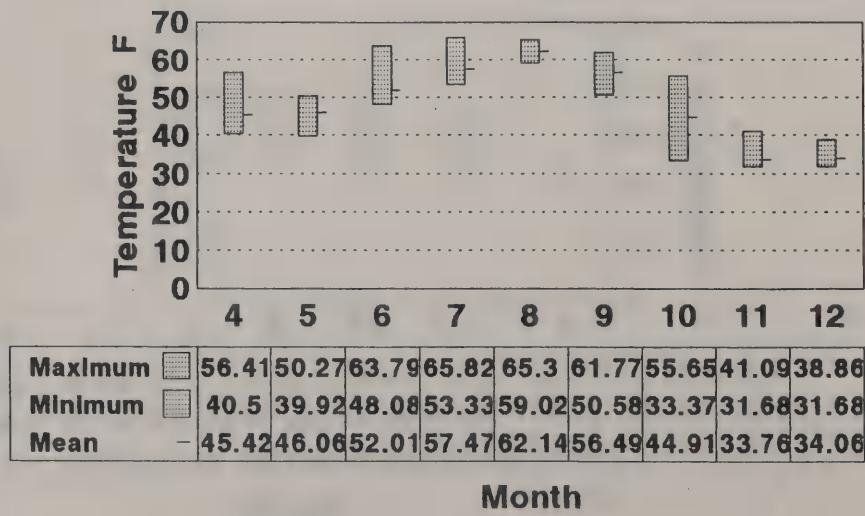
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Nevada Creek above Douglas Creek Water Temperature Summary



Period of Record 8/94 - 10/95

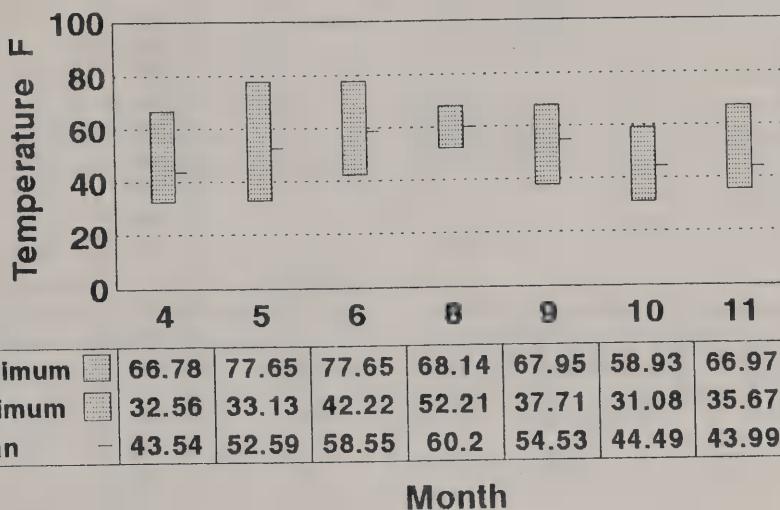
Nevada Creek Below Reservoir Water Temperature Summary



Period of Record 8/94 - 7/96

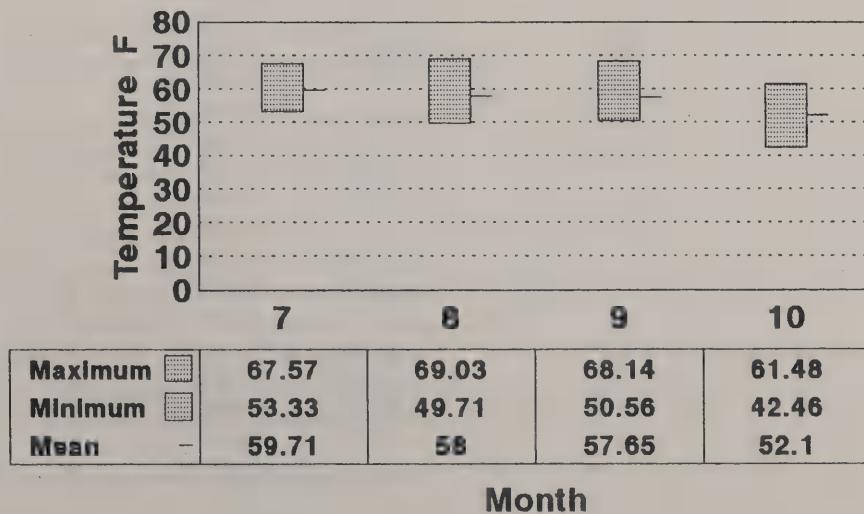
Exhibit G. Water Temperature Monitoring Station Summaries for the Blackfoot River and Selected Tributaries.

Nevada Spring Creek at Mouth Water Temperature Summary



Period of Record 8/94 - 10/95

Rock Creek at Mouth Water Temperature Summary



Period of Record 8/94 - 10/95

Stream	Location (River Mile)	Date	Discharge (cfs)
Arrastras Creek	0.5	23-Aug-89	16.9
Basin Creek	0.6	06-Jun-95	1.4
Beaver Creek	0.2	24-Aug-89	10.7
Belmont Creek	0.1	01-Aug-89	24.3
Blackfoot River	67.8	01-Nov-89	173.8
Blanchard Creek	0.1	05-Sep-90	1
		24-Apr-92	18.6
		06-May-92	7.7
		20-Jun-92	2.6
		02-Aug-95	2.2
	1.1	05-Sep-95	2.6
		08-May-92	10.9
		21-May-93	29.6
	6.5	08-May-92	5.6
canal @ 1.1	0.1	21-May-93	4.1
		02-Aug-96	0.8
		21-May-93	2.3
Clearwater River	0.1	03-Oct-89	98.3
Copper Creek	1.3	30-Aug-89	35.5
Cottonwood Creek	0.2	27-Sep-89	35.1
	0.9	01-Nov-91	30.8
	3.2	31-Aug-90	20.0
		02-Jun-91	38.4
		01-Nov-91	25.3
		12-Aug-92	22.5
	5.6	01-Nov-91	19.7
	6.0	12-Aug-92	21.5
unnamed spring @ 6.4	0.1	07-Nov-91	6.1
	7.0	07-Nov-91	11.3
unnamed spring @ 6.7	0.1	07-Nov-91	2.5
unnamed spring @ 7.5	0.1	13-Nov-91	2.7
	10.5	01-Nov-91	0.0
	12.0	02-Aug-96	12.1
canal @ 12.0	0.1	21-Jun-92	21.4
		10-Aug-92	6.2
		06-Jun-95	23.3
		22-Jun-95	34.7
Chamberlain Creek	0.6	12-Sep-95	2.1
	1.9	27-Jun-95	14.7
		02-Aug-96	4.2
	2.7	03-Oct-89	2.1
canal @ 0.6	0.1	12-Sep-95	0.9
canal @ 1.9	0.1	27-Jun-95	3.2
		02-Aug-96	4.2
Dunham Creek	2.5	15-Jul-96	31.5
canal @ 2.5	0.1	15-Jul-96	9.1
Grantier Spring Creek	1.1	11-Oct-89	4.1
Gold Creek	0.1	06-Sep-89	24.3
Kleinschmidt Creek	0.1	24-Jul-89	25.0
Landers Fork	1.1	13-Sep-89	94.9
Monture Creek	0.4	09-Aug-89	44.2
	8.9	26-Feb-92	24.2

Stream	Location (River Mile)	Date	Discharge (cfs)
Nevada Creek	0.3	01-Nov-89	43.8
	0.5	10-Jul-91	25.3
Nevada Spring Creek	0.7	10-Jul-92	17.2
North Fork of the Blackfoot River	15.5	16-Aug-89	174.4
	2.3	16-Aug-89	299.5
canal @ 8.8	0.1	13-Jun-96	9.9
canal @ 10.0	0.1	13-Jun-96	9.9
canal @ 10.7	0.1	13-Jun-96	5.9
canal @ 12.3	0.1	13-Jun-96	5.7
Pearson Creek	0.1	08-Jun-95	2.3
		02-Aug-96	1.0
	0.8	06-Jun-95	8.2
Poorman Creek	2.2	02-Nov-89	4.1
Rock Creek	0.2	24-Jul-89	53.0
Salmon Creek	0.2	22-Jun-95	7.2
	1.4	22-Jun-95	27.6
canal @ 0.9	0.1	22-Jun-95	10.8
		13-Jun-96	9.0
canal @ 1.4	0.1	22-Jun-95	5.3
Shanley Creek	0.1	13-Nov-91	2.0
Wales Creek	0.1	01-Nov-89	1.4
Union Creek	0.1	17-Oct-89	6.4

Exhibit I: Blackfoot River Multi-spectral Imagery Specifications

Capture date: Summer 1994 and 1995

Spatial Resolution: 1 meter per pixel

Overlap: varies up to 30% side to side

Spectral Bands and Width Bands

Band	Center Waveform/Bandwidth (nm)	Color
1	450-480	Blue
2	460-570	Green
3	610-680	Red
4	780-1000	Near IR

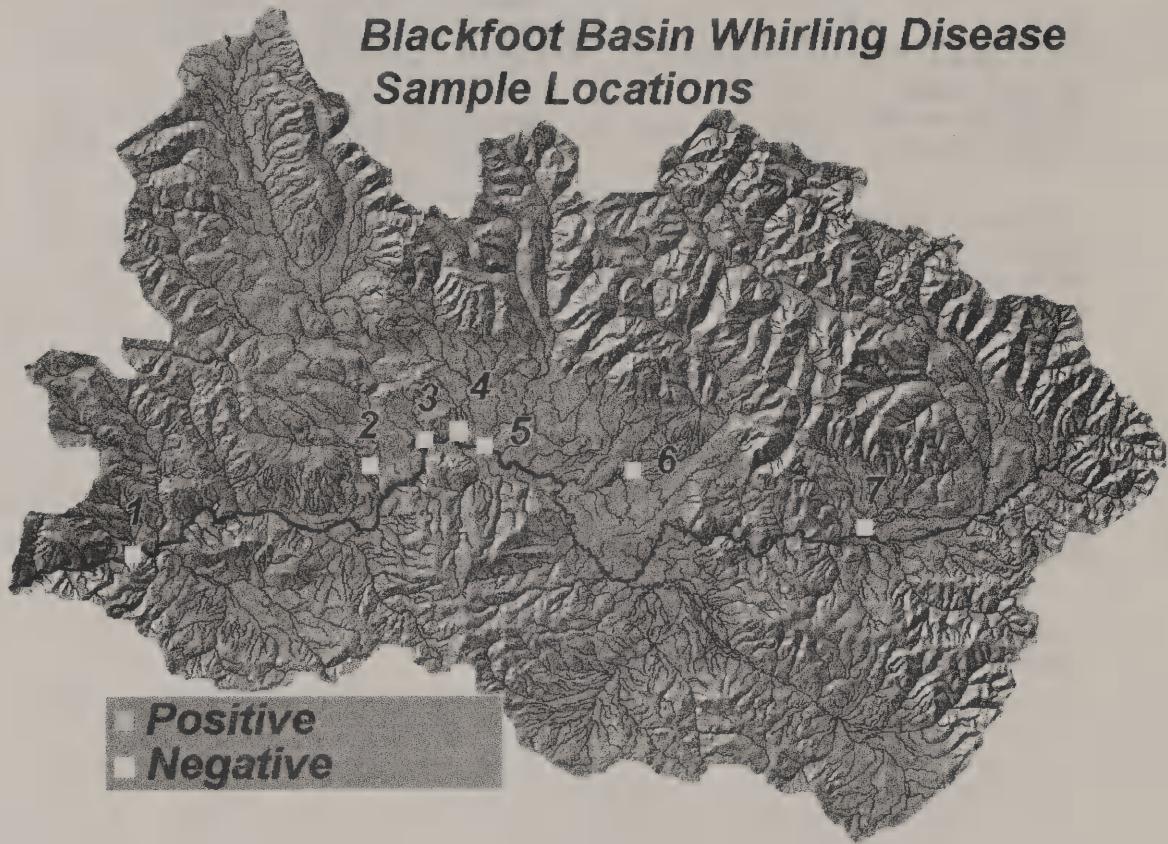
Exhibit J. Bull trout redd surveys in the Blackfoot River drainage, 1996.

Stream	Surveyed	Survey Location	
		Date	(River Miles)
Alice Creek *	Fall	3.3 miles	0
Belmont Creek	20-Sep	0.8-3.0	4
Blackfoot River *	Fall	37.4 miles	2
Cadotte Creek *	Fall	1.8 miles	0
		35.2-36.6,	
Clearwater River	20-Sep	40.5-41.0	0
Copper Creek †	Fall	11.4 miles	37
Cottonwood Creek	20-Sep	11.5-13.5	0
Dunham Creek	26-Sep	2.1-3.2	6
Gold Creek	18-Sep	5.5-9.0	6
West Fork Gold Creek	18-Sep	0.0-3.8	4
Hardscrabble Creek *	Fall	2.6 miles	0
Landers Fork *	Fall	10.0 miles	0
Lodgepole Creek	16-Sep	0.0-0.4	0
Monture Creek	25-Sep	10.5-17.0	79
Morrell Creek	20-Sep	0.0-2.5	1
North Fork of the Blackfoot River	19-Sep	20.0-26.0	59
Totals:		97.4	198

* Streams surveyed by BioAnalysts (Hillman and Chapman 1996).

† Surveyed by Helena National Forest (unpublished data)

Exhibit K. Blackfoot River Whirling Disease Sample Sites and Results.



Site	Water Name	Date (YYMMDD)	Site Description	#Fish	RB	CT	LL	EB	Result
1	Blackfoot River	950418	Upstream West Twin	61	61	0	0	0	-
2	Blanchard Creek	950914	At mouth	60	30	0	30	0	-
3	Blackfoot River	950929	At Russ Gates	41	35	0	6	0	-
4	Cottonwood Creek	961114	Highway 200 Bridge	62	22	0	40	0	+
5	Blackfoot River	950929	Scotty Brown Bridge	19	14	0	5	0	-
		951114	Scotty Brown Bridge	60	55	0	5	0	-
6	Rock Creek	950929	Inlet to raceways	60	42	0	8	10	-
		951103	Inlet to raceways	60	42	0	10	8	-
7	Blackfoot River	951103	Dalton Mtn Bridge	56	0	6	46	2	-

Exhibit L. Documented Eastern Brook trout fish plants in the Blackfoot River drainage from microfiche records.

<u>Stream Name</u>	<u>County</u>	<u>Location</u>	<u>Date</u>	<u>Number</u>	<u>Size (Inches)</u>
Elk Creek	Missoula	14N15WS26	06/28/46	1,000	6
			08/13/47	1,400	6
Elbow Lake	Missoula	15N14WS17	06/03/33	67,000	1
Union Creek	Missoula	13N16W206	06/28/46	1,000	6

